AMERICAN ENGINEER CAR BUILDER AND RAILROAD JOURNAL.

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CONTENTS.

The Erie Railroad is to build five engines at its own shops.

It is stated that the Wabash road will soon be in the market for 1,000 freight cars.

The Lake Shore & Michigan Southern road will soon be in the market for 1,000 coal cars.

The Madison Car Company has been given an order by the Union Pacific, Denver & Gulf for two derrick cars.

The Duluth, South Shore & Atlantic has prepared specifications, and bids are asked for the building of 500 new ore cars.

M. L. Hinman, President of the Brooks Locomotive Works, Dunkirk, N. Y., has recovered from a long and serious illness.

The Pennsylvania Railroad has fitted up a 60-foot car for the purpose of instructing trainmen in the care of steam heating apparatus.

A lift span bridge, 421 feet long, will probably be built across the Missouri River at Kansas City, from the designs of Mr. J. A. L. Waddell.

The Chicago & Northwestern Railway is rebuilding docks at Escanaba, Mich., making 226 pockets. The work will be completed and the docks in readiness by the opening of navigation.

The Maine Central Railroad is using large quantities of Nova Scotia coal, and the Boston & Maine is now trying it on its passenger locomotives, having already extensively introduced it on its freight engines.

Underground electric locomotives at the Marks Colliery in Pas-de-Calais, France, each weighing three tons, draw 30 corves, holding 15 tons of coal, at the rate of 10 miles an hour, thus taking the place of 30 horses.

The Lake Michigan Car Ferry Transportation Company, which transports freight cars on barges between Peshtigo, Wis., and South Chicago, has ordered two additional floats to be ready for service at the opening of navigation in the spring.

The Overland Fruit Despatch, of San Francisco, has placed an order with the Madison Car Company for 100 refrigerator cars, to be built under the Lorenz patents. The cars will be 36 feet long and will be equipped with the Gould couplers.

The estimate of the production of pig iron in the United States is 9,387,639 gross tons. Unless Great Britain shall greatly exceed any previous year's production of pig iron, this is the largest year's production of pig iron of any country in the world.

An Englishman has invented an automatic headlight which so adjusts itself as to throw its rays along the rails on curves. The casing is pivoted to boiler and there is a connection to the frame so that the light turns when the engine enters a curve.

The North Sea-Baltic Canal seems to have stood the test of the first serious frost better than many had anticipated. While ice had almost put a stop to navigation in the Shen and Hadersleben firths, sailing vessels could pass through the canal without any impediment whatever.

An experimental car is to be fitted with electric motors and tested on the New York and Brooklyn Bridge. The trial is to last for thirty days and, if at the end of that time it proves satisfactory, it will be retained in service. It is to be used for switching only, the cable being retained for the hauling of trains.

The new shops of the Atchison, Topeka & Santa Fe at La Junta, Colo., east of Pueblo, are now about completed, and the new machinery is being put in place under the direction of George W. Smith, Master Mechanic of the Topeka shops. The shops are small, but are unusually well built, and have a good modern equipment of tools.

The premium system of rewarding engine drivers in England for saving coal seems likely to fall into ill-repute. A man is awarded £10 at the end of the year if he has not consumed more than a certain number of pounds of coal per mile, and when a driver sees by the coal sheet that his consumption is too high, he deliberately sets himself to lose time.

The *Iron Trade Review* recently published a tabular statement of the output of iron ore from the mines of the Lake Superior region during the past forty years. The grand total amounts to 97,556,866 tons. The greatest output for any one year was in 1895 when it was 10,429,037 tons, of which 5,192,504 tons came from the recently opened Mesabi Range.

The agreement for the construction of the Jura-Simplon tunnel has been definitely signed by the representatives of the Italian and Swiss governments. The termini fixed upon are Brigue, in the Valley of the Rhone, and Ossola, in Italy. Instead of a single double-track tunnel, there will be two single-track tunnels, though only one will be built at first. It is expected that the work will be completed in five years and a half.

On Jan. 6 the Southern Pacific threw open for business the new iron drawbridge across the San Joaquin River near Lathrop, abandoning the old structure. The new bridge was made by the Phœnix Bridge Co., of Philadelphia, and put in place by the Southern Pacific maintenance of way department. It has a total length of 477 feet, the draw span being 200 feet long, the south approach 62 feet and the two northern approach spans 108 and 107 feet long respectively.

During the year 1895 the Baldwin Locomotive Works built 401 locomotives. The output is about 28 per cent. in excess of that of the previous year, when but 313 locomotives were built, and about 52 per cent. of the product of 1893, when 763 locomotives were sent out. Of the 401 locomotives built during the past year, 162 were for export. There are now in hand orders for 90 engines. Of the number 20 constitute the balance of the order placed some months ago by the Russian Government. These 20 engines are now about ready for shipment.

The Pittsburgh Locomotive Works are now quite busy building new engines and on repair work. The shops have an order from the Pittsburgh & Lake Erie for ten 10-wheel freight engines with 18-inch by 24-inch cylinders, which will be larger than any now used by that company. Recently a number of 10-wheel freight engines have been completed for the Lake Shore, and three passenger engines and three switching engines for the Cincinnati, Hamilton & Dayton. A number of freight engines have been rebuilt for the Wheeling & Lake Erie, the Pittsburgh & Western and other roads.

Notwithstanding the fact that narrow gage railways have not been a success in this country, there are some 1,550 miles of these light railways in France. But, if reports speak true, they are not proving to be a very profitable investment to the government, who has guaranteed the interest on the stock for a greater portion of the mileage. Taking the lines as a whole, there was a small profit on the working during the first six months of the year, amounting to about $35 per mile. This is not a result which would allow the lines to be operated as a purely commercial undertaking, but the interest on the shares being guaranteed by the Government, the stockholders can view the situation with equanimity.

The French Ministry of Public Works has recently addressed a circular to the various French railroads with regard to some of the complications arising from the fact that enginemen are paid premiums for time made up. It is believed that certain dangers follow the custom of giving such premiums, because the enginemen are tempted to run too fast when they have lost time. These dangers are modified, it is true, by the premiums for fuel saving and by the rules fixing the maximum speeds. It is thought important to avoid excessive speeds, and yet it is no less important to avoid delays, which disarrange the traffic and cause complaints from the public, and which are often the cause of accidents. The railroad companies are requested to make a study and report concerning the system of premiums, both for time gained and for fuel saved, in their relative effects, and also to consider and report upon the practicability of a general use of registering speed records.

Mr. Clement E. Stretton, who may be called the railroad historian, calls attention in the *English Mechanic* to the fact that in some of our American passenger engines with large Wootten fireboxes the engineer is located over the driving wheels, and the fireman, while at work, stands on the tender, and commenting thereon says:

"It is a well-understood fact, both in America and in England, that practically the duties of the firemen are so great with express trains that they can give very little attention to looking out; and as the guards are so fully occupied with duties in their vans, in practice it comes to this—that the driver must take the whole "lookout" upon himself.

"The time will no doubt come (perhaps after an accident) when a man will be appointed to keep a lookout and nothing else."

It is hoped that Mr. Stretton's anticipation of an accident from this cause may not come true although it must be admitted that "in that direction danger lies."

The *Railroad Gazette* states that the Beech Creek Railroad for the year ending with June last had the heaviest average freight trainloads and at the same time the lightest passenger trainloads that we have ever seen reported. That it is a freight road is shown by the fact that for its 187 miles of railroad worked it has 2,876 freight and service cars and only 11 passenger cars, and that it is essentially a coal road by the further fact that of every 100 tons carried 94 were coal. The average trainloads last year were 14 passengers and 575 tons of freight. Substantially all of the freight goes in one direction; there was but 1 ton westbound to 55 eastbound, so that the trainloads taken out must have averaged 1,150 tons. The economy of the heavy loads, and the costliness of the light ones; are both emphatically shown by the earnings per train mile, 38 cents for passenger trains and $2.31 for freight trains, although the average rates were 2.58 cents per passenger mile and only 0.38 cent per ton mile. The latter would seem to be ruinously low, but the road earned not only its fixed charges but a dividend of 4 per cent. on its capital stock and had a small surplus left.

Among the most recent and novel applications of wire, attention is drawn in *Hardware* to the wire flywheel lately erected at the Mannesmann Tube Company's works, Germany, and especially notable, in view of the well-known fact that heavy flywheels, driven at high velocities, present such dangers of breaking asunder from the great centrifugal force developed. The wheel at the factory mentioned is described as a cast-iron hub or boss, to which are attached two steel plate disks, or cheeks, about 20 feet in diameter. The peripheral space between the discs is filled with some 70 tons of No. 5 steel wire, completely wound around the hub, the tensile resistance thus obtained being found to be far superior to that of any casting. This huge flywheel is driven at a speed of about 240 revolutions per minute, or a peripheral velocity of 2.8 miles per minute, or approximately 250 ft. per second, which is said to be nearly three times the average speed of any express train in the world. For such a constructed flywheel the length of wire is estimated at about 250 miles. The use of paper is also regarded with favor for large flywheels, the tensile strength of paper being enormous, and it is quite possible that some of the new big wheels will be built up with a paper rim.

Professor Arnold, of the Sheffield (England) Technical School, is carrying out a series of experiments which promise to have an important bearing on the future of the steel trade. Hitherto, as is well known, steel makers have had to rely upon the chemical analysis of steel for determining its composition; but practice has shown that two steels may have exactly the same chemical composition and yet one be tough and strong and the other rotten. The reason of this was a mystery until the aid of the microscope was brought to bear upon it. The difficulty has been how to prepare the samples for the microscope, and, as the result of tedious research, Professor Arnold has solved the problem, and has reduced the preparation of samples of steel to a system so easy that it can be carried out in an ordinary steel works' laboratory. The microscope has shown that steel must no longer be regarded as a homogeneous substance, containing the constituent elements discovered in iron, but that steel is more allied to geological structure, or, as Professor Arnold puts it, "steel is an igneous rock made up of crystals of pure iron, of carbide of iron with inter-crystalline spaces filled with the compounds of the constituents of steel." This is quite a new theory, and opens up a wide field of practical information for steel makers.—*Locomotive Engineer and Fireman's Journal.*

The Chicago Main Drainage Canal is to-day probably the most interesting engineering work being carried on in the world, and is an interesting exposition for contractors' machinery. The visitor to this canal is at once impressed by the great number of traveling cableways. As built by the Lidgerwood Manufacturing Company, of New York, they are to be found on nearly all the rock sections on the canal. On section two, McArthur Bros. use two cableways; on section three, the Des Plaines Consolidated Company use four; on section four, McArthur Bros. use two; on section five, the Quailey Consolidated Company use two; on section six, Mason, Locher & Williamson use four; on section seven, Locher, Harder & Williamson use one; on section eight, Mason & King three, and Locher, Harder & Williamson two. The only reason why about ten more cableways were not installed on this work was because the traveling cableway was not perfected in time. It is a fact that cannot be controverted, however, that since the traveling cableway demonstrated its present capacity no other hoisting and conveying machine was sold on the canal. One cableway was used on the river diversion work, and is now no longer used. However, the balance, 19, can be seen in daily operation—in fact, working day and night. The traveling cableway is capable of handling 600 cubic yards of rock in place per day of 10 hours, and any capacity short of that is due to the difficulty of loading the skips.

Notes on Russian Engineering.*

BY CHARLES HYDE.

At the station at which we crossed the frontier from Germany to Russia, called Eydkunnen on the German side and Virballen on the Russian side of the line, the gage of the railroad changes from the standard gage of 4 feet 8½ inches, which prevails throughout Holland and Germany, to 5 feet, the standard gage of the Russian roads. As this railroad is regarded as a means for the transportation of troops rather than passengers or merchandise, this change of gage is intended to prevent any sudden invasion from either side, the inconvenience of the change as regards the commercial use of the railways being completely ignored, the military character of this railroad in particuliar being still further emphasized by the fact that it runs in almost a straight line from the frontier station of Virballen to St. Petersburg, except where necessary to connect with a for tress or military station, while important trading towns on the Baltic Sea and Gulf of Finland are reached only by branches or not at all.

The Russian cars of the first-class are commodious and comfortable, being constructed on the same plan as those largely used in Germany, viz., with a corridor running along one side, and private rooms connecting with this corridor running across the car. The extreme width of the car being 10 feet, allows for a corridor of about 2 feet 6 inches wide, and a room 7 feet long inside measurement. I may mention that on most of the roads there are four classes, so that one has plenty of choice as regards accommodation.

The Northern railroads use wood for the most part as fuel, which, though plentiful and clean, has the drawback inherent to a fuel of low calorific value, that the power developed is small in proportion to the weight consumed, and, consequently, the speed of the trains is slow, averaging about 25 miles only per hour. The stoppages made, too, are rather frequent, and to one anxious to get through, appear inordinately long; but as the trains do not carry dining or buffet cars, a stop of from 30 to 45 minutes about meal times is appreciated, especially as the buffet arrangements at the stations are first-rate.

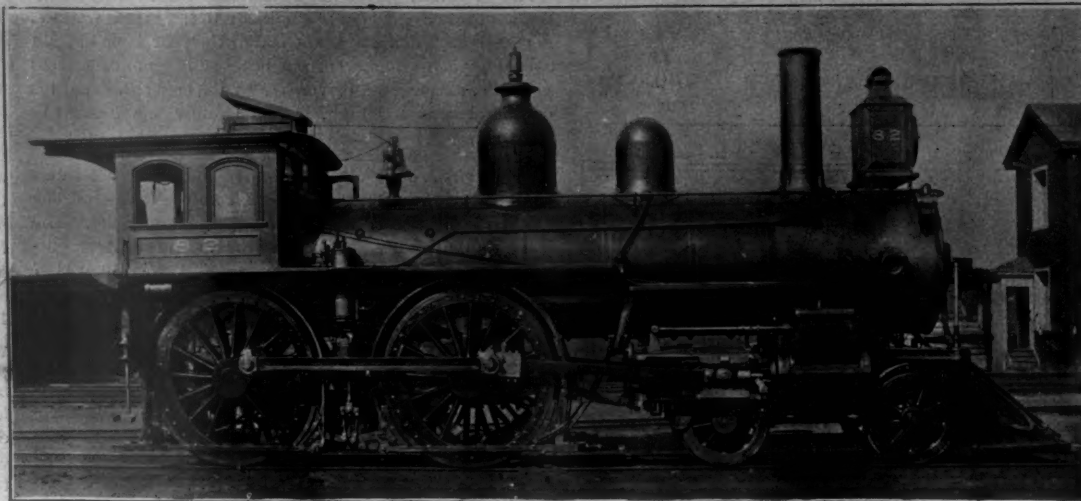
Many of the saints' days, too, are observed by closing the stores and sometimes the works, so that it is always advisable in making arrangements ahead for visiting works, picture galleries or stores, to make careful inquiries beforehand. It is also the custom, which seemed curious and just a little ridiculous, to have a shrine in each department of a works—the Bessemer open hearth rail mill, hammer shop, machine shop, etc., each having its shrine to its patron saint right in the midst of the smoke and dust of the mill; and no plant can be operated unless these shrines are provided, at least in St. Petersburg. The government also insists upon the operators of a plant providing baths, hospitals and dwellings for their employees unless the works are situated in a large city, when the latter requirements may be dispensed with.

Although the neighborhood of St. Petersburg has very few natural advantages as a manufacturing center, there are a number of important industries carried on there, principally in the hands of the government or engaged in work for the government. Among the former there are the government glass and china factories; a large plant for the manufacture of playing-cards, of which the government has a monopoly; and the shipbuilding yards, from which the largest ironclad in the Russian Navy was launched during our stay. Among private concerns engaged in government work there are the Poutilof, Neviski, Alexandrovsky and others. The first three are steel works, and each of them was visited.

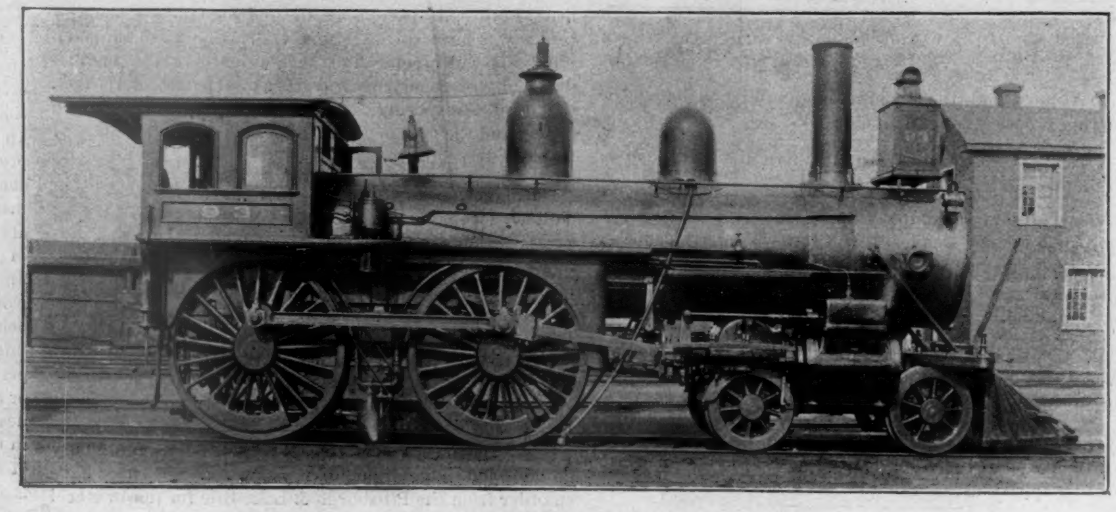
At the largest of these, the Poutilof works, they employ about 7,000 men, have a Bessemer and open hearth department, and manufacture rails, plates, beams, angles, channels, axles, tires, bars and general merchant iron. In addition to this they build locomotives, torpedo boats, gun carriages, bridges and buildings, and also have a special department for the manufacture of projectiles, which department no visitor is allowed to see. Some of the product, however, was exhibited—among other things a solid shot which had passed through an armor plate, the point of the shot being practically as good as when fired.

The whole of their raw material is imported; principally from England, and a six months' supply of pig, coke and coal must be stocked before the winter sets in. The duty on everything is high, which, together with freight, makes coal cost from

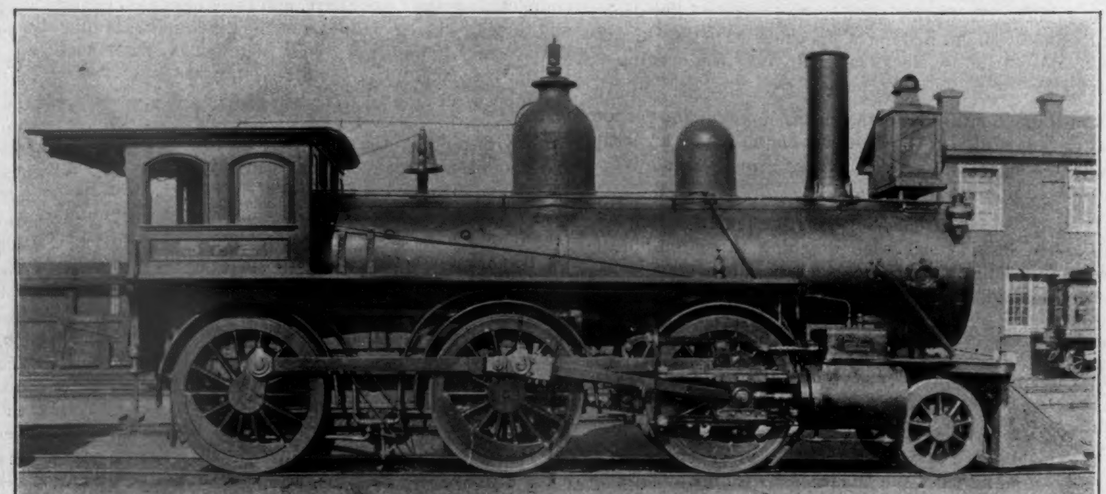
* Abstract of a paper read before the Engineers Society of Western Pennsylvania.



Express Passenger Locomotive with 18-inch by 24-inch Cylinders.



Express Passenger Locomotive with 18-inch by 26-inch Cylinders.



Mogul Freight Locomotive with 18-inch by 26-inch Cylinders.

Double Ended Suburban Passenger Locomotive with 17-inch by 22-inch Cylinders.

STANDARD LOCOMOTIVES OF THE GRAND TRUNK RAILWAY.

$4.40 to $5 per ton, and coke $6.80 to $7.50 per ton, and pig iron $27 to $28 per ton.

The Bessemer department contains two 4-ton vessels, three iron-melting cupolas and one spiegel cupola. The spiegel is tapped directly into the pouring ladle and not into the vessel; hydraulic pressure used for cranes, tilting, etc., is about 300 pounds per square inch. The open hearth department contains twelve 10-ton furnaces in a straight line, having a casting pit extending the full length, the ladles being carried on trucks extending across the pit, and running on rails laid on either side. The molds and ingots in this department are handled by traveling steam jib cranes, which seem to answer the requirements very well. Ingots for rails are bloomed down on a reversing mill in 10 passes to an 8-inch bloom, which is transferred on a buggy to a three high rail mill, and finished in 11 more passes. The capacity of this mill is about 200 tons per day, all the work of drawing and charging the furnaces, transferring and manipulating being done by hand. Labor-saving appliances are but little used in any of the Russian mills, especially in St. Petersburg, as labor is cheap in spite of the high tariff on everything—common labor being paid about 40 cents a day and skilled labor from $1 to $1.50.

The finished product of both the rail and structural mills looked first class, in fact it must be good to pass the very rigid government inspection, while the steel castings which they were making to take the place of forgings in gun carriages and locomotive construction equaled anything of the kind I ever saw.

The plate mill department is rather old-fashioned, having been built 15 or 20 years ago; the widest plate they could roll would be about 80 inches, I should judge; and in this department, as elsewhere, the number of men employed appeared excessive for the amount of material turned out as compared with our modern mills.

In the locomotive shops a great deal of new machinery had been recently added, and the general equipment was fairly good, but too crowded. Overhead cranes, some operated by steam, some by ropes and some by electricity, handled the material in the smith, machine, hammer or erecting shop, as the case may be, and the flanging and riveting work on the locomotives turned out was first-class in every respect. The government inspection was not only rigid, but absurdly arbitrary in some respects, though any one who has had much to do with government work knows perfectly well that unreasonable requirements and arbitrary inspection is not confined by any means to Russia.

The compound type of locomotive seems to be coming into very general favor, there being several different arrangements in use, though the favorite type appeared to be with the high pressure on one side and low on the other.

In the St. Petersburg mills, for the most part, the mill engines are of the non-automatic type, while as to boilers, I noticed in the Poutilof works, alone, boilers of the modified Babcock & Wilcox, the Lancashire, Cornish, horizontal tubular locomotive and plain cylinder type, many of these boilers being fired by the waste heat from heating furnaces.

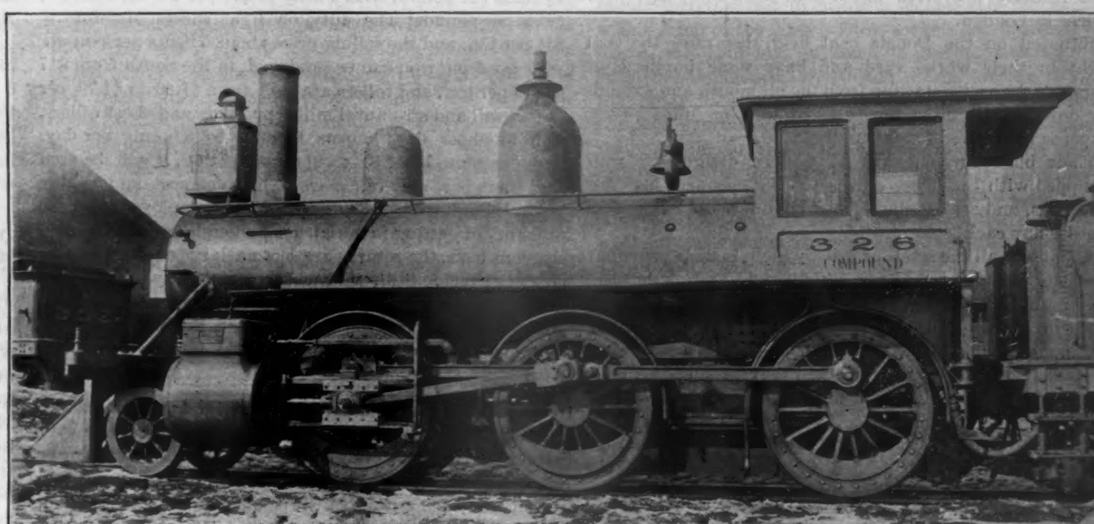
At the "Nevski," another large works on the Neva, above St. Petersburg, there are two open-hearth furnaces of the acid type, as are all those at the Poutilof, and here also they build torpedo boats and locomotives. As illustrating the extreme rigidity of the government inspection I was informed that out of 200 plates submitted to the inspectors for the artillery department only 24 were accepted, the rest being rejected principally on tensile strength and ductility test. Sixty plates were ordered from the Belgian firm of Cockrill & Co., in order to complete their contract, and out of these 60, 48 were rejected.

At the Alexandrovsky works, the principal output of which consists of plates and structural material, they have seven open-hearth furnaces, of which six are operated by the basic process. The metal is tapped directly from the furnace into the moulds, they being set on a revolving table in a small circular pit and brought alternately under a fixed funnel.

The object of this arrangement was, presumably, to save expense for pits, cranes and ladles. What the effect would be if the furnace broke out, as furnaces sometimes will, can be readily imagined by any one familiar with open-hearth practice. It is bad enough where you have a clear pit and good crane capacity without having a lot of mechanism in the pit, and cranes capable only of handling moulds and ingots to depend upon.

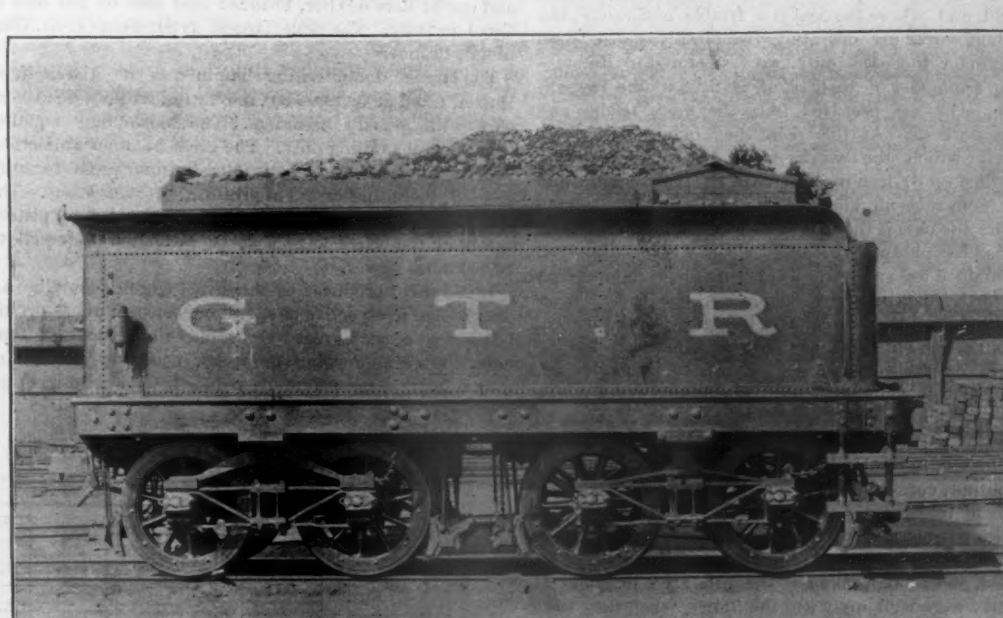
For rolling their plates they have a reversing mill operated by a three-cylinder engine, and all the plates are passed through straightening rolls as they come from the mill. The result is a very fine-looking plate of smooth surface and free from buckles. Very little handling is done here by mechanical means, as many as 17 men being

Light Passenger Locomotive for Local Service with 17-inch by 22-inch Cylinders.



Experimental Compound Locomotive of the Rhode Island System.

STANDARD LOCOMOTIVES OF THE GRAND TRUNK RAILWAY.



Standard Tenders Used on the Grand Trunk Railway.

required to draw a 5,000-lb. ingot from the heating furnace and take it to the rolls.

At Moscow, at the Gougon works, the arrangement of the open-hearth plants struck me much more favorably than did that of the St. Petersburg works, though, of course, the latter plants were older. At the Gougon works the furnaces, two in number, were of about 30 tons capacity each, with plenty of room both on the side of the charging floor and on the pit side, which was also properly equipped with hydraulic cranes. Crude petroleum from the Caspian Sea, brought up the Volga and Oka rivers in bulk in covered barges, is largely used for fuel at these works both for heating and boiler purposes, but it is not used in the open-hearth furnaces, nor did the method of using it seem the most economical. At the end of the furnace, and on the outside, the oil is allowed to fall in drops into a shallow iron trough, where it is ignited and is drawn by natural draft into the furnace At these works, too, they have recently put in some compound automatic engines built in England; have a good modern mill, and well-equipped nail, spike and wire factory. For this class of work they can compete successfully with other districts, but for heavy products they are handicapped on account of the high freights on all raw material. For fuel they are dependent upon coal and coke from England or Germany, or oil from the Caspian, a distance of some 1,500 miles, while much of their pig iron is either imported or comes from the Urals, a distance of a thousand miles.

As regards oil, too, all this distance is against the stream, and the Ural pig must come against the stream for at least half the distance, and I know from personal experience what pulling against the stream in the Volga means. During half the year, too, the rivers are not navigable on account of the ice.

Although there is an abundant supply of rich ore in the Ural Mountains, it is impossible to smelt it in large quanti-

ties there, owing to the absence of any fuel except charcoal; the government restrictions as to the quantity of timber felled in any district per annum, and other requirements as to smelting, rendering it difficult to produce iron in large quantities in this region, though the finest ores in Russia, and possibly equal to anything in the world, are found here. There is a fortune in it for any one who can devise a practical means of smelting Ural ore with crude petroleum, as the ore can be floated down to any point on the Volga to meet the oil from the Caspian.

Several schemes have been proposed, among others to soak coke in petroleum, and use the standard coke, which might possibibly be of use if you could keep the oil from volatilizing long enough to be of any use in reducing the ore. Others claim to be able to reduce the ore by means of the oil, without the use of coke at all, but the schemes referred to me did not seem to hold out much hope of success.

The coming district in Russia for the manufacture of steel on a large scale is undoubtedly in the south, as that is the only district where coking coal is found in large quantities of a good grade; and here, too, there are some good hematite mines, notably at Krivoi-Rog.

The most successful plant in this neighborhood, and possibly in Russia, is the New Russia Iron Works, founded by a Mr. Hughes, an Englishman, in the early seventies, and recently converted into a joint stock company, with offices in London.

Situated on the Donetz coal field, they raise the coal right in their works yard, and have some hundreds of Coppee coke ovens, starting from the pit mouth and extending down to the blast furnaces, so that no unnecessary expense is incurred for re-handling.

Their blast furnaces are of modern design, are well equipped with hot blast stoves and independent blowing machines, and are capable of turning out about 200 tons of pig per day each.

At present all the steel for rails, which is their principal product, is made by the open-hearth acid process, but the metal is charged in a molten state from the blast furnaces. Their main reason for building an open hearth instead of a Bessemer plant was because at that time all the railroads in Russia were using iron rails, and they proposed to melt old rails and convert them into steel, which promised to be a remunerative business until, during the American boom of 1881, the price of iron rails rose to such a figure that the whole country was scoured for them, they being sold in large quantities, and imported steel rails put down in their place.

The Hughes Company are now, however, erecting a Bessemer plant and rail mill on modern lines, which will greatly increase their capacity and reduce the cost of manufacture.

At Sulina, on the extreme eastern edge of the Donetz coal field, and where the coal is a friable anthracite, the Postuchoff works are operating two blast furnaces with anthracite for fuel—the only two so operated in Russia—and the remainder of their plant is fired by the raw anthracite, or by gas prepared from the more friable and gaseous portions. At this point they obtain on the property on which the works stand limestone, building stone, silica sand, iron ore and coal, so that the location would seem to be an ideal one for a steel works, which would be the case if the iron ores were richer in iron and contained less phosphorus, and the coal were coking coal and contained less sulphur. They were about to erect two open-hearth furnaces here, one acid, one basic, using chrome ore from the Caucasus for lining the latter furnace.

In connection with this plant, where we were treated in the most hospitable manner—which, to be perfectly fair, was the case in connection with practically every works in Russia which we visited—the manager was anxious to have some particulars of the working of blast furnaces, on anthracite, in the United States, as regards the dimension, output, consumption of fuel per ton of pig produced, pressure of blast, etc.

Speaking generally of the steel and iron industry in Russia, it is more advanced than is generally supposed by outsiders, and though many of the mills are a little out of date, they were well up with the times when they were built, and with the recent revival of business there, and the encouragement given by the Government to open up new districts by the building of railroads, the manufacturers are taking advantage of the opportunity to remodel their plants on the most modern lines. The locomotive works of the Strauvee Company at Colomna are being equipped throughout with electric overhead cranes, hydraulic riveters, multiple drills, etc., and in the case of large tools, each one is driven by an independent motor. The Siemens-Halske Company have a large and successful plant in St. Petersburg, from which they ship motors and general electrical appliances all over Russia, and at the same time give object lessons, by the way in which their own shops are operated, as to the best and cheapest methods of running machine shops and similar establishments.

One of the oldest steel works in Russia is the Sormovo works at Nijni-Novgorod, where, besides making plates, tires and axles, and general merchant iron, they also manufacture a great many freight and passenger cars, and build compound engines for the vessels plying on the Volga. We traveled all night from Moscow to see these works, only to find them standing on account of its being a saint's day.

The town of Nijni-Novgorod is most widely known as the site of the great fair that takes place in August of each year, which it is said as many as 750,000 people annually visit either for trading or sight-seeing. But it is expected that the construction of the Siberian Railroad will soon reduce the importance of the fair, if not kill it altogether, as the necessity of its existence will cease as soon as com nunication with the people interested becomes rapid and regular.

Russia to-day offers a very inviting field for the establishment of manufacturing industries, especially in the direction of iron and steel, and more particularly as regards material required for railroads. The works visited by us were all running full time on orders showing good profits, and the government had some large contracts for rails, locomotives and armor plates to give out, some of which have since been placed. At present the building of railroads is hampered by the difficulty of obtaining rails and equipment, and with the present capacity of the mills and factories, it will take years to make up the existing deficiency, without counting the extensive districts in Russia itself, outside of Siberia, which are without railroad communication of any kind.

Rails were worth $47 to $51 per ton in St. Petersburg when we were there, or about $40 at the mills in the south, there being a duty of $20.50 per ton. Plates were worth about 4¼ cents per pound, with a duty of $29 per ton and tires 5¼ cents per pound. The duty on light sheets amounts to $34 per ton, and the selling price about 5 cents per pound.

As good pig iron can be produced in the South from $17 to $18 per ton, and rollers are paid from $1.60 to $1.70 per day in rail and structural mills, puddlers and sheet rollers, $1 to $1.20 per day; helpers from 45 to 50 cents per day, and common labor 35 to 40 cents per day, it will be seen that there is a very fair margin between cost and selling price, though from the number of men employed, and the difficulty of getting material good enough to pass the government tests, the returns are not as large as they appear on the surface. Still, with modern machinery and assured government contracts, which would be necessary, as the government is by far the largest buyer, Russia appears to offer one of the best fields in the world for investment today.

The great steam hammer, at the Bethlehem Company's works in Pennsylvania, is at this time the largest one ever made. It is single-acting, that is, the falling movement or blow is by gravity alone, steam being employed only to raise the "tup," as the British people call it. The falling weight is 125 tons, and the range 16.5 feet. The whole structure is 90 feet high from the floor, and the foundations extend 30 feet below, so the whole height is 120 feet. The piston rod is of steel, 16 inches in diameter. There are in use two other hammers of 100 tons, one at Creusot, and one at Rive de Gier, France; and one of 109 tons at Terni, in Italy. The next largest is 80 tons, at St. Chamond, France.

The largest double-acting hammer is at Aboukoff, in Russia, rated at 50 tons, but this rating will not do to compare with gravity hammers. The blows may equal in force 100 tons falling only. The great hammer at Bethlehem is outdone by a hydraulic forging press recently erected there that exerts a pressure of 14,000 tons. The force is not accumulated, but is direct by steam pistons acting on the water with a force estimated as equal to 16,000 horse power.

If the effect produced by these vast engines could be accomplished irrespective of speed or velocity there would be no need of such great weight, but an element of time enters into these forging processes, necessary because of inertia in large masses to be reduced, and also because some time must be allowed for the heated metal to flow when under pressure. This is more nearly attained by a heavy weight falling slowly.

The increase of hammers to the enormous proportions named is to acquire this time required, the principle culminating in the forging presses, more commonly employed all over the world for heavy work, especially in England, where hydraulic apparatus has attained the greatest development. The presses acting slowly permits the metal to move uniformly throughout, or "to the center," as it is called, while a quick blow acts only on the surface.

A familiar example of this is in the use of hand hammers which, as all know, must have weight in proportion to the object struck, independent of the dynamic energy of the blows. Pile driving is another illustration. A light ram splinters the piles without moving them.—*Industries.*

The Standard Locomotives of the Grand Trunk Railway.

The officials in charge of the mechanical departments of the Grand Trunk Railway have taken great pains to standardize all parts of their rolling stock, so that the expenses for repairs have been lowered and the necessity of carrying a multiplicity of parts avoided. Their standard box car was illustrated and described in the *American Engineer* in 1895, and we now present a series of illustrations of the standard locomotives that are used, including all with the exception of the switching engine.

The class of which No. 82 is a representative is used on express service where the trains are comparatively light. The cylinders have a diameter of 18 inches, with a piston stroke of 24 inches and drivers 6 feet 1¼ inches in diameter. It will be noticed that the tires on the drivers of this engine are held by Mansell retaining rings, that the connection for the driver brake is outside the wheels, and that while the portion of the engine above the running board shows the touch of the English influence in the smoothness and simplicity of the outlines, the mechanism is typical of American practice.

No. 93 belongs to a heavier class. Its cylinders are 18 inches diameter, with 26-inch stroke, and has drivers 6 feet 6 inches in diameter, which are of wrought iron, with tires held by the Beattie clip and tire bolts. It is used on the heaviest and fastest express service of the road, and, besides its weight and the dimensions of cylinders and driving wheels, is very similar to No. 82.

No. 572 represents the standard freight locomotive. Its cylinders have a diameter of 18 inches and a stroke of 26 inches, with a driver diameter of 5 feet 2 inches.

In No. 39 we find a double ended locomotive used in suburban passenger service, for, though Montreal is a comparatively small city, there is quite a heavy suburban traffic especially during the summer months. These locomotives haul five cars and are capable of picking up to speed with great rapidity. The cylinders are 17 inches by 22 inches, with 5 feet 2 inch drivers. The engine is practically an ordinary eight-wheeled locomotive with a trailing truck having two wheels. Engines similar to this have been in use on the Long Island Railroad for a number of years. This latter road had a number of light eight-wheeled passenger engines that were not heavy enough for regular service, so the tender was dispensed with, tanks placed along the running board, and a small coal space provided at the back. These Grand Trunk locomotives are similar, except that they were especially designed for the service in which they are working and have the advantages of ample coal and water space.

Finally we have the light passenger locomotive as illustrated by No. 196. The cylinders are 17 inches in diameter with a piston stroke of 22 inches, and drivers 5 feet 2 inches in diameter. The engine is used on local and accommodation trains.

On all of these engines it will be noticed that there is a great similarity in the design of all of the working parts, and that there is one feature that is very rare on this side of the border line. We refer to the jacketing of the firebox. The usual custom prevalent here of leaving the firebox to the tender mercy of all the breezes of heaven is a necessity for that portion of the firebox between the top rail of the frame and the running board, where it is occupied by the reach rod and the equalizer; but between the rails there is nothing to interfere with the jacketing, so our Canadian brethren, believing that a half loaf is better than no bread, have filled this space with a protective jacketing.

The compound locomotive illustrated is the only one that is owned by the road, and so has not arisen to the dignity of a class. Elaborate experiments are being conducted in order to determine its efficiency both in passenger and freight service. It has the Rhode Island type of intercepting valve. The cylinders are 19 inches and 29 inches in diameter, with a piston stroke of 26 inches, and drivers 5 feet 2 inches in diameter.

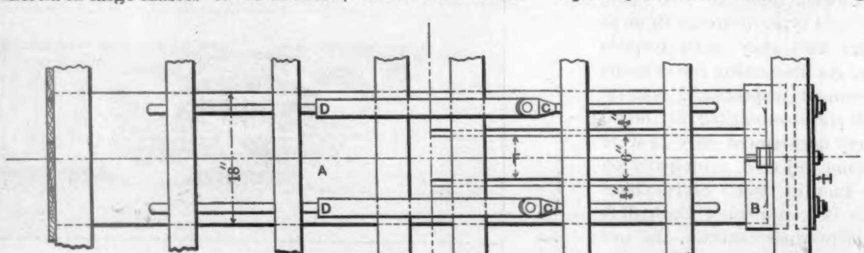


Fig. 4

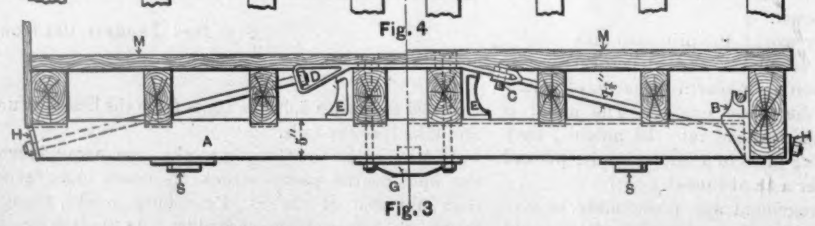


Fig. 3

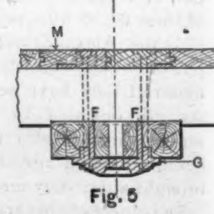


Fig. 5

All locomotives upon the road are equipped with the one standard tender. This is illustrated very clearly by the engraving which we present. The tires are held by Mansell retaining rings, the brakes are hung from the framing, the truck is of the diamond type, with an intermediate arch bar, and the flare of the tank is curved instead of being straight, as we are accustomed to see it.

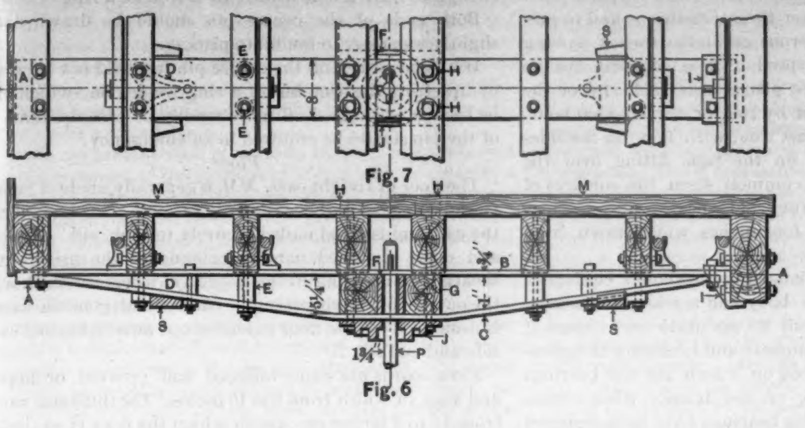


Fig. 7

Fig. 6

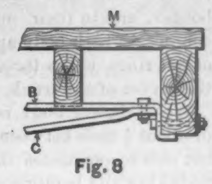


Fig. 8

The table on page 29 gives a very complete list of the dimensions of these locomotives, while those of the tender used are as follows:

PARTICULARS OF STANDARD TENDER, GRAND TRUNK RAILWAY.

Weight of express tender, empty (43-in. wheels)...........34,944 lbs.
Number of wheels under tender 8
Diameter " " " 37 in. and 43 in. for express and 33 in. for freight.
Style of " "C. 1." center, steel tires and "Mansell" clips.
Axles, center to center of journals.....................6 ft. 4 in.
Diameter and length of journals ....3⅝ in. × 7 "
" of wheel seat.......................................5⅝ "
Trucks, from center to center of truck wheels.............4 ft. 8 "
" " " " trucks ....10 " 6 "
Springs—Front truck, center bearing springs, length, 3 ft. 8 in. unloaded, by 1 ft. ½ in. set unloaded. Number of plates, 14; section of steel, 4 in. × ½ in.; back truck, center bearing and side bearing springs, length of center bearing springs, 3 ft. 7½ in. unloaded by 1 ft. 1¼ in. set unloaded; number of plates, 11; section of steel, 4 in. × ½ in.; length of side bearing springs, 4 ft. 4½ in. unloaded by 1 ft. 1½ in. set unloaded; number of plates, 10; section of steel, 4 in. × ½ in.
Total wheel base of tender.............................15 ft. 2 in.
" length of tender over all, express...................23 " 6¾ "
" " " " " freight...................22 " 3½ "
Style of frame, wood; length by width ....20 ft. 8 in. × 8 ft. 9 in.
Capacity of tank in gallons, of 231 cubic inches ....3,600 gals.
Coal capacity of tender in pounds..........................20,000 lbs.
Tank—Length, width, depth, 20 ft. × 8 ft. 4 in. × 3 ft. 8½ in. inside.

Construction and Maintenance of Railway Car Equipment. II.

BY OSCAR ANTZ.

(*Continued from Page 3.*)

Body Bolsters.

The body-bolsters have to carry the entire weight of the car body and transmit it to the trucks, and must therefore be made strong and stiff. As the distance between the bottom of the floor-frame and the top of the truck-bolster is limited, the body-bolster, which has to be placed within these limits, together with the center plates, must necessarily vary somewhat with the conditions encountered; in a great many cases, however, when building different classes of cars, a design can be adopted which will suit the greater portion of these cars of the same capacity with few if any changes.

Although there is considerable variation in the details of the design and construction of body-bolsters, the general idea of all of them, with few exceptions, can be traced to one of two designs or a combination of these, leaving out of consideration for the present, bolsters of recent construction made of pressed steel.

The first and simplest body-bolster is the wooden one, which has been in use since cars with independent trucks were first built, being merely a piece of timber at each truck center, extending across the car under the floor frame, from outside to outside of side sills, and to this timber the body center plate and side bearings are fastened. At first this bolster was of small cross-section, in proportion to the rest of the frame, but as the strength of the cars was increased, it was made heavier, and eventually provided with truss rods. On modern cars of a capacity of 60,000 pounds having wooden body bolsters, each of these is about 5 or 6 inches thick and 18 inches wide, and is trussed with two 1-inch to 1½-inch truss rods. It is gained out ½ inch for each longitudinal sill and each of these is also gained out ½ inch for the bolster, whereby displacement in either direction is guarded against. The bolster is fastened to each longitudinal sill by two or more bolts and usually some of these bolts are utilized to hold the attachments on the bolster, viz.: center plate and side bearings.

In Figs. 3 and 4 the part to the left of the center line shows a wooden body bolster *AA*, and its general relation to the frame of the car, where all the sills are of the same depth.

Cars which have the side sills deeper than the other sills require a change in the end of the body bolster, and in the earlier cars this was framed into the side sills by mortise and tenon. With the heavier cars, however, this fastening was not substantial enough and a casting in the shape of a pocket, into which the end of the bolster was framed, was resorted to, and this in turn was bolted to the side of the side sill and lipped under it, as shown at *BB* to the right of the center line in Figs. 3 and 4.

The truss rods of wooden body bolsters are usually made in three pieces, which facilitate their application and removal. The two end pieces are from 1 inch to 1½ inches in diameter and have large cast or wrought iron washers, *HH*, under the nuts on the outer end, the plane of contact with the nut being at right angles with the line of the rod. The central part of the truss rod is preferably made of flat iron, to distribute the strain over a larger surface of the center sills, and sometimes castings, *EE*, are introduced, which are bolted to the sills and give additional support to the rods.

The usual methods of connecting the three parts of the truss rods are shown in Figs. 3 and 4, the one on the right being a jaw connection, *CC*, which is an easy one to make, but it requires the removal of the floor for its application. The one shown on the left, *DD*, can be connected from the outside without disturbing the floor, and although it is more expensive to make than the first it is the more extensively used of the two.

To further strengthen wooden body-bolsters the width is sometimes divided into three parts and plates of iron ⅜ inch thick *FF* are inserted between these pieces, the whole being securely bolted together. The iron plates should not be quite as deep as the wood, so as to be below the notches which are gained for the sills, and to prevent their projecting beyond the wood if this should shrink.

This style of bolster is shown in Figs. 3 and 4 to the right of center line and in cross-section in Fig. 5. It is not a popular construction, as the wood is liable to shrink, leaving the bolts loose, whereby all the advantage gained by the introduction of the plates is lost.

The second kind of body-bolster, the iron one, Figs. 6 and 7 is the favorite with car builders at present. This is made of two bars of flat iron, the upper one straight and the lower one bent in the form of an inverted arch, the ends being fastened together and the bars spaced as far apart at the center as is necessary and possible, the distance at this point being limited by the space between floor frame and truck-bolster. This makes a strong and stiff bolster, which is easily repaired and allows part of the draft gear to be carried through between the top and bottom members to the center of the car, so as to distribute the shocks to which the draft rigging is subjected to the framing. The space between the two members also provides a convenient location for air-pipes and brake rods, keeping them away from the top of the trucks.

Sometimes the two members of the body-bolster are welded together at the ends, but this is not an advisable plan and is not widely practiced at present. A better method of fastening is to weld a lug on the bottom of each end of the top member, about 2½ inches wide and of the depth of the lower member, against which lug the latter bar is made to fit neatly, as shown at *AA*.

The usual width of iron bolsters for 60,000 pounds capacity cars it 8 inches, but a few roads use them a little wider. The thickness of the upper or tension member *BB* is generally ⅝ inch, and that of the lower or compression member *CC* is ⅞ or 1 inch. The two bars are well bolted together, with distance pieces between them to preserve their relation to each other. These distance pieces have been made of wood especially where the bars were welded together at the ends and then usually the entire space is filled, excepting, perhaps, at the center. The wood, however, is liable to shrink and it is therefore not very extensively used for this purpose, and castings or thimbles of wrought iron pipe are applied instead. When two or more bolts come close together, one casting, as at *DD*, can be made to take them all, at other points it is usual to have a separate casting *EE* for each bolt, usually cylindrical in shape, and often enlarged at the ends in order to distribute the bearing surface. At the center of the bolster a casting *FF* is sometimes placed, through which the center-pin passes, which is lipped over the sides of the bolster and is held in place on the sides by parts of the draft rigging. When bolts pass through timbers such as these just mentioned, distance pieces made of wrought iron pipe *GG* can be used to advantage, as castings would necessitate too much of the wood being cut away.

The bolts which tie the two bars of the bolster together are usually carried up through the floor-timbers, and with the exception of those at the center, have plate-washers under the heads resting on the sills; although on box and other cars with a framed superstructure the bolts through the ends of the bolster are often utilized to hold some of the pockets in which the posts and braces rest. The bolts at the center occasionally require removal, as in the case of repairs to the draft gear, and the heads of these bolts should therefore rest in cast-iron sockets *HH* let in flush with the top of the floor. These sockets are usually cylindrical, with thin lugs on them to prevent turning. The bolts mentioned are also utilized where possible to fasten the center plate and side bearings, and their number and size are determined by the requirements of these attachments. The bolts through the center plate are four in number, ⅞ inch in diameter, the balance being of ⅝ or ¾-inch iron, two to each longitudinal sill, and those which do not pass through the side bearings have cast-iron washers under them, shaped to the angle of the bolster at their respective locations.

The bolster just described is shown in Figs. 6 and 7, the parts to the left of the center line being for a car with all sills of the same depth. For cars of different widths the same pitch can be preserved for the lower member, excepting between the outside intermediate and the side sill, where the end must be curved to suit the different width of car. By this means the same distance castings and other attachments can be used throughout.

On cars with side sills deeper than the other sills the end of the bolster is mortised into the side sill, and is further supported by a casting, *II*, securely bolted to the bolster and side sill and lipped under the latter; the upper part of this casting can also serve as a saddle for the body truss rod. Figs. 6 and 7 show this arrangement on the right of the center line, the truss rods being spaced for a car with central drop doors.

Another method of supporting the end of an iron bar-bolster, where the side sills are deeper than the others, is shown in Fig. 8; the upper member is carried down on the inside of the side sill and lipped under it, the compression member is fitted against the upper corner so formed and is securely bolted to it, the tension member being bolted to the side sill.

As mentioned above, the distance between the two members of an iron bar-bolster is limited and usually does not exceed six inches. If more of an arch is desired, or when, on account of an unusually low floor or high truck, sufficient space between the latter parts cannot be obtained for a proper depth of bolster, the tension member can be placed on top of the floor timbers, as shown in Figs. 8 and 9, carried down on the inside of the sills, and under them. The compression member, which is placed below the sills, being turned up on the ends and fastened near the upper corner to the tension member, as at *A*, or it may be fastened to castings, *B*, which themselves are bolted to the tension member and side sills. In these cases the sills act as distant pieces between the two bars; at the center it is usual to place a casting or piece of timber, *C*, between the bottom of centre sills and compression member, the outside intermediate sill has to be cut away, as at *D D*, on the bottom, for the compression member, which is an objection to this style of bolster; another objection is the fact that the tension member cannot be removed without considerable work.

This style of bolster can be used advantageously in cases

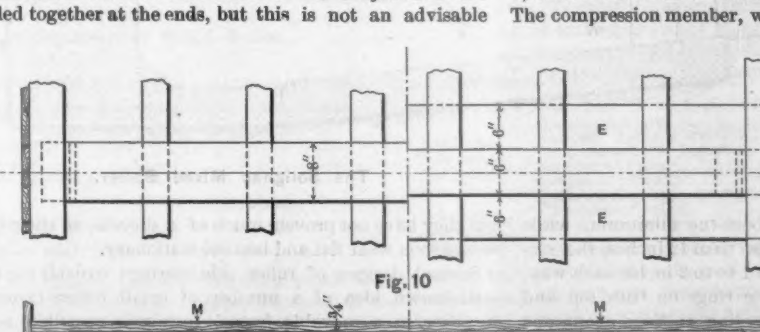


Fig. 10

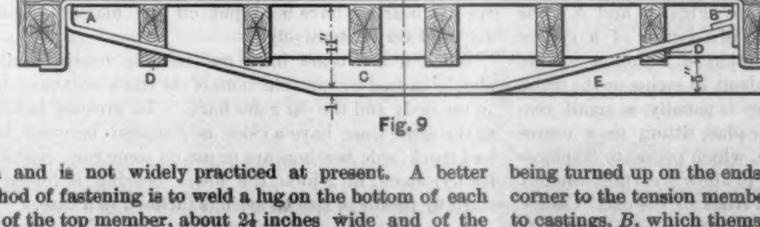


Fig. 9

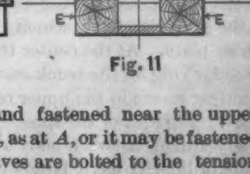


Fig. 11

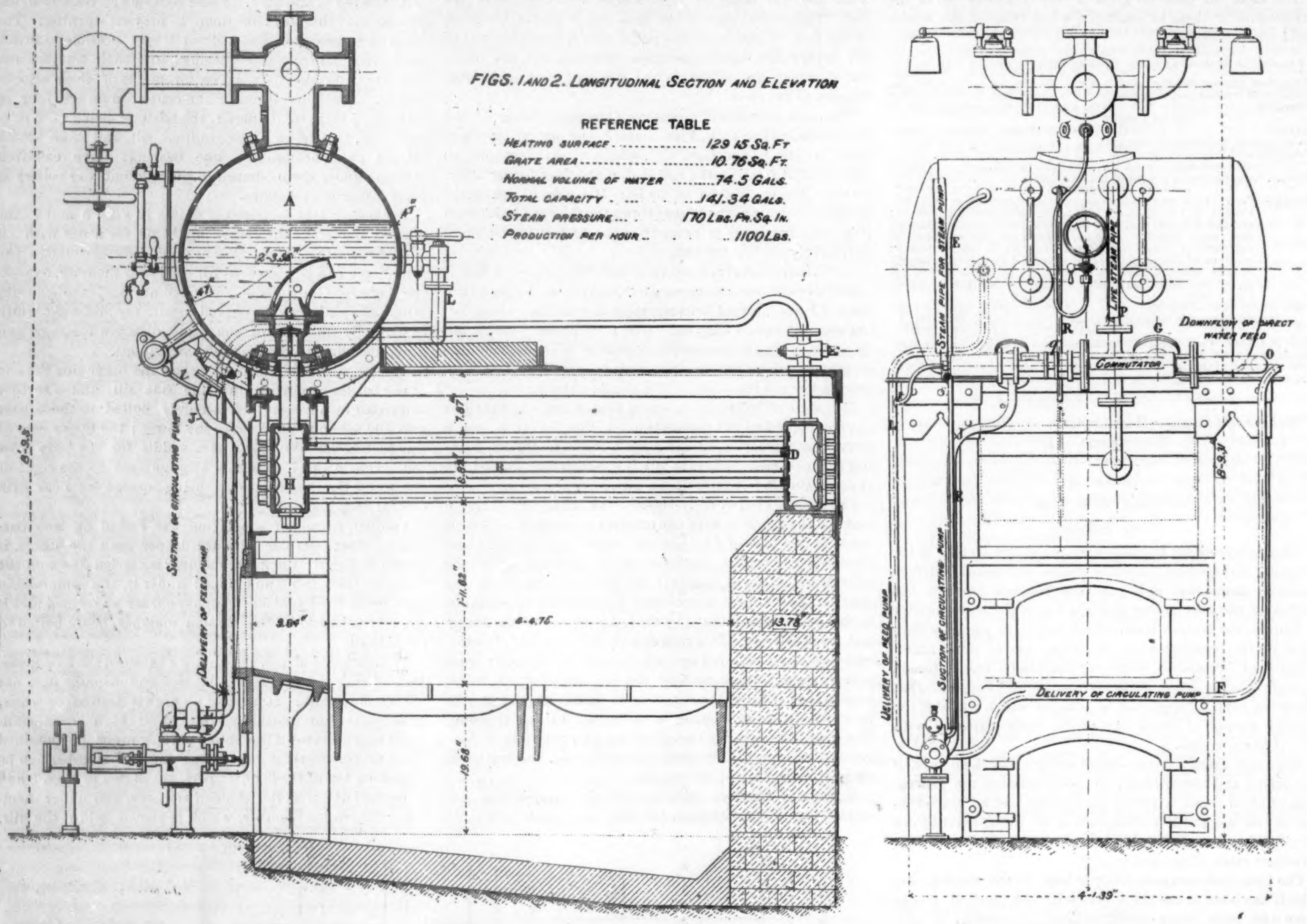
where the draw-bar attachments are fastened directly to the center sills of the car.

A combination of the wooden and iron body bolsters, is used on some roads, an iron-bar bolster, 6 inches wide, with the tension member on top of the sills is reinforced on each side by a piece of timber, *EE*, 5 inches deep and 6 inches wide, making a bolster 18 inches wide, the bottoms of the iron and wood being in one plane at the center; castings which lap over on to the wood parts are placed between the center and inside intermediate sills and the compression member of the iron part. Figs. 9 and 10 shows the general arrangement of this combination bolster to the right of the center line; it is shown in cross-section in Fig. 11. In addition to the body bolsters described, a number of others have been designed in which iron or steel channel bars or *I*-beams are used, but as comparatively few of these are in existance, and these principally on special kinds of cars, they will not be described here in detail.

Center Plates.

Center plates are usually made of cast iron, although pressed steel is coming into use to some extent. Those of cast iron are limited to one or two styles, the more common being that shown at *JJ*, Figs 6 and 7, which consists of a ring of rectangular section cast to a flat plate, this ring fitting loosely into a similar ring on the truck center plate. The size of the section, as well as the diameter of these rings vary greatly, but four inches for, the inside diameter of the smaller ring is about the minimum, while the largest diameter is usually less than 12 inches, the section of the ring ranging from 1 to to 2 inches each way. Some builders use two concentric rings on both top and bottom center plates, and their section is then about one inch square. This is shown at *GG*, Figs. 3 and 5. The other style of center plate consists of a section of a sphere on the body plate, resting in a section of a hollow sphere of the same diameter, which is about 10 inches on the truck center plate. At the center there is usually a small rectangular ring on the truck center plate fitting in a corresponding recess in the upper one, which prevents displacement. The idea of the sphere is to allow a certain amount of adjustment between body and truck of the car. Center plates ordinarily have flanges or lips on the sides which fit over the bolster and relieve the bolts of some of the strain. On wooden bolsters, especially when they are very wide, the flanges are sometimes omitted, and lugs are placed on the flat side of the plate which is let into the wood. These lugs are often made cylindrical, about one inch in diameter, and of the same length, but it is found that they frequently break, and stronger ones of rectangular section, about 1¼ inches square and 3 inches long should therefore be used.

The center plate should be fastened very securely to the bolster, and four bolts ¾ inch in diameter are found to be about right.



The Solignac Mixed Boiler.

Side Bearings.

The weight of the body of a car is carried entirely by the center plates when the car is on a straight and level track, and the weights of the body and load are evenly distributed each side of the center line; these conditions however, do not always prevail, and the center of gravity will not be directly over the center of the truck. As the center plates are comparatively small, other supports must therefore be provided to meet these conditions and to prevent undue and often dangerous oscillations when passing around curves at a high speed. These supports are the side bearings, *SS*, which are placed near each end of the bolster and are fastened to it by two or three ⅝-inch bolts. They are usually made of cast iron, with lugs on the sides for the bolts and flanges on the ends fitting over the bolster, and in their most common form the surfaces of contact on both body and truck side bearings are sections of flat rings, about three or four inches wide, drawn from the center of the truck.

When the car body is balanced there should be a space of about ¼ inch between the body and truck side bearings, but this is sometimes difficult to maintain on account of shrinking and bending of timbers and loosening of fastenings, and many cars are found on which the side bearings are in contact, causing more or less friction when rounding curves. To overcome this bearings have been designed in which a roller is supposed to do away with the friction, but they have not proven much of a success, as the roller would soon wear flat and become stationary.

Several designs of roller side bearings embodying the well-known idea of a number of small rollers fastened together in a movable frame, forming a so-called anti-friction bearing, have been put on the market, but none are used very extensively.

When a car bears hard on the side bearings all the shocks caused by imperfections of the track are transmitted to the body and the car rides hard. To prevent this, and at the same time have a close adjustment between body and truck, side bearings are in use on some cars, especially for live stock, in which the lower bearing is forced upward by means of special springs inclosed in a case.

Center Pin.

The center pin (*P*, Fig. 3,) is a bar of round wrought iron, generally from 1½ to 2 inches in diameter, which passes through the body and truck center plates and bolsters and holds these parts in their relative position in case the plates should become broken or the body of the car be raised high enough for the center plates to disengage themselves. The pin is also a guide when putting the body on the trucks and is usually put in place before the body is let down.

Center pins are sometimes made with heads resting either on top of the body-bolster or in cast-iron sockets let into the floor; this, however, is not a desirable plan, as the pin cannot be removed or replaced conveniently, especially when the car is loaded. The pin shall have a slot in its upper end, through which a flat key of wrought iron passes, which rests on the top of the body-bolster and can be removed easily to allow the pin to drop low enough to remove the truck. This key should be about ⅝ by 2 inches in section, with a head on one end and the other end long enough to have a hole drilled in it to take a ring or cotter.

Both ends of the centre pin should be drawn down slightly tapering, to facilitate placing.

If a head is used on the centre pin it should not be made by upsetting the iron, but of a ring welded on, which can be broken or chipped off more readily in case the removal of the pin should be required in an emergency.

Floor.

The floor of freight cars, *MM*, is generally made of yellow or Norway pine and occasionally of oak. It is laid across the car, and is blind nailed securely to each sill. On box and other sheathed cars it extends to the inside of the sheathing, excepting in the doorway, where it is flush with the outside of the sheathing. On flat and gondola cars it is usual to have the floor extend about an inch beyond each side and end sill.

Floor boards are either tongued and grooved, or lapped, and vary in width from 6 to 10 inches. The thickness varies from 1¼ to 2 inches on cars on which the floor is subjected to only ordinary wear, such as box and other merchandise cars, and from 2½ to 3 inches on cars on where heavy materials such as coal, ore, stone, etc., are carried.

(To be Continued.)

The Solignac Mixed Boiler.

This boiler, as it is now built, varies very widely from the original one as it was first put upon the market. Like all new inventions, it has been subjected to successive transformations, based upon the very legitimate desire of satisfying all of the practical requirements that may be made upon it, and of taking advantage of everything that experience may have suggested. In its present form, however, it seems to have reached this goal, so that it is deserving of a careful examination, as being among that class of generators in which the production of steam is very high. The inventor, M. Solignac, calls it a mixed boiler because it partakes, at the same time, of the characteristics of those boilers carrying a large volume of water and of those composed of elements intended for the instantaneous generation of steam.

These two conditions, each of which would seem to necessarily exclude the other, could only have been harmonized with the greatest difficulty by the ordinary means, and it has only been by boldly turning aside from the beaten pathways that M. Solignac has been able to attain the results that he has.

We know that the free production of steam in multitubular boilers is intimately connected with the rapid renewal or circulation of water in the tubes; then, as it is a poor

conductor of heat, it is quite natural that, in its course through the tubes, that portion which comes in direct contact with the metal should be heated more than that lying in the center and forming the core, as it were. Whence we see the necessity of giving the water the highest possible speed of flow in order to protect the tubes from an excessive temperature, and consequently reaching a coefficient that is too high for the proper transmission of heat. Again, even though the tubes may be perfectly free to expand, the greater or less activity in the circulation of the water none the less limits the intensity of the fire within bounds which it would not be prudent to exceed unless we are willing to expose ourselves to the dangers of a bursting tube—an accident that is especially liable to occur when running under a forced draft.

From the present view of the case, the circulation is caused by the ascension of the globules of steam, and this creates a difference of pressure between the top and bottom portions of the boiler that tends to check the circulation. But in spite of this detrimental influence, and in spite of the sudden changes in the direction of flow, the fact remains that the water does have a comparatively rapid rate of flow, one engineer of high authority estimating it to be about 16½ feet per second, corresponding to about 200 circuits of the water before it is finally transformed into steam. Is it possible, then, to expect an increase in the speed of circulation, and consequently an increase in the amount of water evaporated per square foot of heating surface, from the mere fact alone that there is a better opportunity afforded for the liberation of the steam? In the opinion of M. Solignac, the maximum has been nearly reached in this direction, so he has abandoned the beaten tracks and sought a radical solution of the problem. His researches have led him to dispense with the natural circulation due to the disengagement of the steam, and to produce it with increased intensity by the forced injection into the evaporating elements of a stream of hot water taken from a reservoir that is under pressure and which is not in contact with the gases of combustion, and which in itself forms a steam drum.

Under the influence of the expansion at the outlet of the nozzles used for this forced injection, the water is thrown into the tubes in so fine a spray that its particles take no part in the convection of heat to one another; but, possessing as they do nearly all of the heat that is required for their complete evaporation, these particles come successively in contact with the metal of the tubes at a high velocity, and this is exactly the conditi n that insures a very high coefficient in the transmission of heat. Thus the spray is evaporated as it advances through the tubes and leaves them in the form of dry steam, and enters the reservoir or drum that is under pressure and from which the injection water is taken.

Contrary to the usual practice, this steam does not rise into the dome of the drum, but enters the body of water where it drops to a temperature corresponding to the pressure. At the same time the steam is liberated from the upper surface of the water more or less abundantly, according to the absorption of heat by the cold feed-water and the generation of the steam, leaving a greater or less amount of heat available for the latent heat of evaporation.

It is an interesting fact that by suddenly heating the cold feed water in this reservoir the greater portion of the impurities contained therein is precipitated, and such salts as escape this first precipitation cannot lodge in tubes, for they are driven out by the strength of the current.

We may admit, as a basis for the construction of this boiler, that the steam which is sent into the water reservoir is entirely condensed, so that, in order to compensate for the consumption of heat due to the evaporation of 100 pounds of cold water, for example, it is necessary that it should give up all of its heat to the same weight of steam. Starting from the principle of instantaneous evaporation, M. Solignac might have adopted a section of tube that was just sufficient for the flow of this quantity of steam; but in order to have an ample margin outside of his calculations, he has adopted a section that is considerably larger. Under these conditions he has obtained 100 kilogrammes of steam per square meter (20.46 pounds per square foot) of heating surface with an internal diameter of tube that has been invariably fixed at .95 inch and an efficiency of 8 pounds of steam per pound of coal; so that the boiler is very much smaller than the ordinary one of the same capacity, as can be seen from an examination of the dim nsions given in the illustration, which represents a boiler capable of generating 1,100 pounds of steam per hour.

We have at *A* a water drum that is under pressure and away from the fire; it is put in communication with the collector *H* in front of the nest of tubes *B* by means of the valve casing *C*. At the back end each tube is provided with an injection nozzle, and is expanded into the shell of a collector, *D*, into which the delivery from the circulating pump *I* is led by means of the pipe *F*. This pump is in communication with the reservoir *A* through the pipe *J*, and is a direct-acting Blake pump, as shown in the sections (figs 5 and 6). Steam is furnished to the motor cylinder by the pipe *E* that leads off from the steam space. The circulating pump is driven by side connections coupled directly to the piston rod, which is in line with the plunger of the feed pump *K*; the latter drawing water from any convenient source of supply and delivering it into the reservoir *A* through the pipe *L*, that is provided with a suitable check valve. The following are the principal dimensions of the pumps:

Feed.

Diameter of piston	2.17 inches.
Stroke	3.94 inches.
Delivery per hour	211 gallons.

Circulating.

Diameter of piston	2.95 inches.
Stroke	3.94 inches.
Theoretical delivery per hour	423 gallons.

We thus see that the circulating pump has a delivery far above the theoretical volume on account of the temperature of the mixture that flows into it, as a matter of fact, its delivery is 1,100 pounds of water.

At the front and in a horizontal position we find an apparatus called a commutator, which plays a double *role*; it permits the reheating of the water while under pressure, and in doing so it automatically prevents the tubes from being deprived of water should the pump cease to act. This commutator (Figs. 3 and 4) consists of two differential pistons, *m* and *n*, that move in independent cylinders placed in a line with each other; the plunger *m*, at the left, receives through the pipe *t* the pressure normally existing in the feed pipe *L* (Fig. 2); as for the the piston *n*, its front face is in communication through the pipe *O* with the collector *D* at the back end of the nest of tubes.

When in its normal position the piston *n* covers the opening *G* of a pipe leading to a cock mounted upon the reservoir *A* below the water level; further, an obturator, *p*, solidly fastened to the large piston, closes the pipe, *P*, which directly connects the steam space of the reservoir with the collector *H* in front of the nest of tubes.

It is now easy to understand how the operations are effected.

When the reservoir *A* is provided with the proper quantity of water, the stem *q* of the commutator is pushed by hand, so that the two pistons, *m* and *n*, and the obturator, *p*, are at their position to the extreme left. Then the water flows from the reservoir, *A*, into the collector, *D*, and passes through the tubes; the steam produced rises and escapes by the pipe *P* to the top of the body of liquid. The temperature of this latter gradually rises, and when it corresponds to a pressure of 14 pounds per square inch the Blake pump is started; straightway the pressure due to its delivery is exerted upon the plunger *m*, which is thus driven to the right and pushes the piston *n* in the same direction until it strikes against the stop made for it in its own cylinder. In this position the piston interrupts the direct flow of water from *G* into *O*, and the obturator *p* closes the pipe *P*. At the same time the circulating pump *I* receives a supply of hot water from the reservoir through *J*, and delivers it through *F* into the back collector *D*, whence it is forced through the nozzles that spray it into the evaporating tubes *B*. Starting from this point, the production of steam becomes intense; the pressure in the reservoir increases very rapidly, it being at the rate of about 14 pounds per square inch per minute, so that all of the water soon reaches the temperature corresponding to the existing pressure.

We obtain this pressure more or less rapidly, according to the amount of water that is pumped into the reservoir *A* at the beginning; and if, to hasten it the reservoir has not been filled to its proper level, it can be raised by running the pump. A pipe, *R*, connects the steam dome with the front collector *H* in such a way as to insure the latter being always kept free from water.

As steam is drawn off from above the plane of evaporation, the body of water furnishes a renewed supply, thanks to the heat carried into it by the steam, which, issuing from the valve *C* enters the mass; and in order to secure the b st possible conditions of mixture, a sort of trumpet with circumferential holes has been placed above the valve *C*, which insures the thorough commingling of the steam that is generated in the tubes with the water.

On account of the arrangements used, the plane of water from which evaporation takes place has a large surface that is always calm, which, coupled with the spacious volume of the reservoir, is very favorable to the production of dry steam.

If, while the boiler is at work, the pump should be accidentally stopped, the load due to the pressure in the delivery on the plunger *m* of the commutator disappears, and as the pressure existing in the collector *D* of the tubes continues to be exerted upon the piston *n*, the latter is driven to the left, carrying the plunger *m* with it, and the boiler continues its action with a feed from a direct flow of water. Then the stem or bridle *q*, which previously stood opposite the word "Pump" (Fig. 3), comes to be opposite the word "Direct" so that the fireman is notified that the commutator is in operation. In an installation now in course of erection this notification is completed by an audible signal in the form of a whistle that is blown by the bridle *q* as it starts in the movement to the left.

This boiler possesses numerous advantages. First is its safety; in this respect the rupture of a tube would have no other effect in normal working than to cause the valve *C* to close, and only that small amount of steam that was contained in the nest of tubes at the time could escape into the firebox; and furthermore all the joints of the tubes are away from contact with the fire.

In the second place, the size and weight of the boiler is greatly reduced on account of the small dimensions of the heating surface; furthermore, the flexibility of the power of this boiler is so great that it is possible, without any fear of overheating, even with a forced draft, to give dimensions to the reservoir corresponding to the rating of the boiler; and if there is a shortness of water due to the draft made upon the steam, a defect in the feed will have no serious consequences, because the reservoir is not in contact with the fire.

As for economy, this boiler has shown itself to be economical from the threefold standpoint of first cost, maintenance and consumption of fuel.

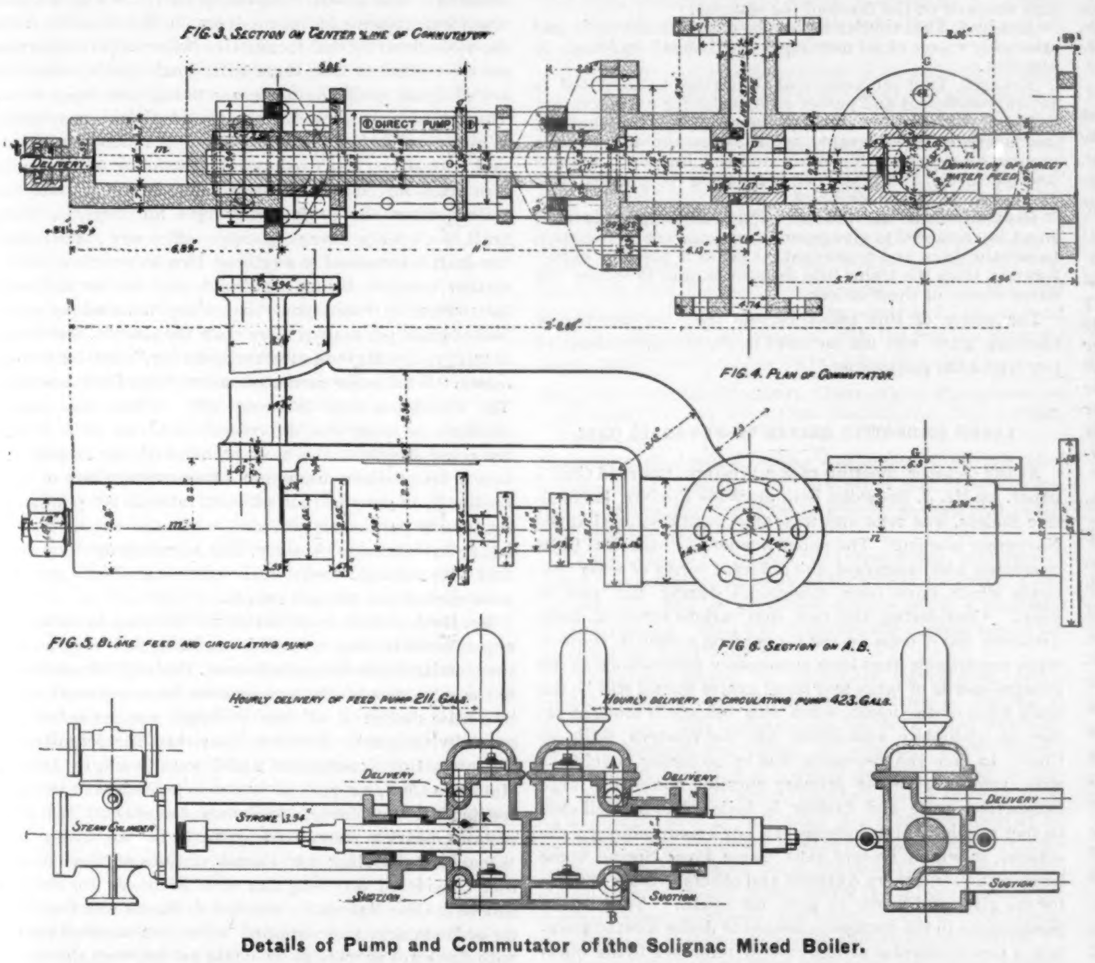
To show the saving in first cost which is the direct result of cutting down the heating surface, we give below some dimensions of two types, one having a capacity of 1,100 pounds and the other of 6,600 pounds per hour:

	1,100 lbs.	6,600 lbs.
Grate area	10.76 sq. ft.	51.66 sq. ft.
Heating surface	129.15 sq. ft.	644.33 sq. ft.
Normal volume of water	74.5 gals.	358 gals.
Total capacity of boiler	141.34 gals.	671 gals.
Number of tubes	82	300
Length of tubes	5 ft. 1.42 in.	6 ft. 10.68 in.
External diameter of tubes	1.18 in.	1.18 in.
Thickness of tubes	.12 in.	.12 in.
Steam pressure (lbs. per sq. in.)	62½	62½

As for the economy of maintenance, it is due to the simplicity of the boiler and the efficiency with which the tubes are kept cool, these being, as we have said, always of a dead black color while the boiler is at work, showing the rapidity of the absorption of the heat of the firebox; and, besides this, all of the elements are interchangeable, even between boilers of different powers. Finally, in order to show exactly what has been done, we cannot do better than publish the results of some experiments that have been made with this boiler. They are as follows:

Grate area	10.76 square feet
Heating surface	65.6 square feet
Number of tubes	30
Natural draf.	....
Pressure in pounds per square inch	71
Temperature of feed-water	41 degrees F.
Water evaporated per hour	1,430 pounds.
Coal burned (gross weight)	166 pounds.
A hes	16.5 pounds.
Coal burned (ne)	149.5 pounds.
Water evaporated per square foot of heating surface	21.8 pounds.
" " " pound of coal consumed	8.61 pounds
" " " " " " burned	9.56 pounds.

Mr. Elias B. Dunn, head of the weather bureau at New York, has devised a system of electrical signals for railroads which consists of a series of red-lights at short distances and frequent switches which, in case of accident, are operated to cut in the line of signal lights. The idea at present has been especially arranged for the requirements of the Brooklyn Bridge.



Details of Pump and Commutator of the Solignac Mixed Boiler.

(Established 1832.)

AMERICAN ENGINEER CAR BUILDER AND RAILROAD JOURNAL.

27TH YEAR. 65TH YEAR.

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EDITORIAL ANNOUNCEMENTS.

Advertisements.—*Nothing will be inserted in this journal for pay,* EXCEPT IN THE ADVERTISING PAGES. *The reading pages will contain only such matter as we consider of interest to our readers.*

Special Notice.—*As the* AMERICAN ENGINEER, CAR BUILDER AND RAILROAD JOURNAL *is printed and ready for mailing on the last day of the month, correspondence, advertisements, etc., intended for insertion must be received not later than the 25th day of each month.*

Contributions.—*Articles relating to railway rolling stock construction and management and kindred topics, by those who are practically acquainted with these subjects, are specially desired. Also early notices of official changes, and additions of new equipment for the road or the shop, by purchase or construction.*

To Subscribers.—*The* AMERICAN ENGINEER, CAR BUILDER AND RAILROAD JOURNAL *is mailed regularly to every subscriber each month. Any subscriber who fails to receive his paper ought at once to notify the postmaster at the office of delivery, and in case the paper is not then obtained this office should be notified, so that the missing paper may be supplied.* **When a subscriber changes his address** *he ought to notify this office at once, so that the paper may be sent to the proper destination.*

At the annual convention of the Master Car Builders' Association held last June, a resolution was adopted, to the effect that the different railroad clubs be requested to each appoint a committee of three representative members of the association, the joint committee so appointed, to take into consideration the general remodeling of the M. C. B. rules of interchange. That committee has just published its report, which has been sent to members of the association and will doubtless call out a great deal of discussion. The committee has gone into the subject very fully, especially into the defects of standard couplers, and their report makes a pamphlet of 26 pages. Thus gradually, year by year, a system of law for the operation of railroads is being evolved and it seems probable that there will be a mechanical Blackstone, and a Kent's commentaries on cars, before very long.

New York City is to have an electrical exhibition, commencing on May 4 next and continuing until June 1. The exhibition is to be held under the auspices of the National Electric Light Association in connection with its nineteenth convention, and promises to be the largest and most interesting display of electrical apparatus of all kinds ever made in this country. The exhibition will be held in the great Industrial Building, which occupies the entire block on Lexington avenue between Forty-third and Forty-fourth streets. Many novel and unique features in electrical displays will be introduced in connection with the exhibition. There will be given a series of popular and practical lectures on electrical subjects by eminent scientists, also afternoon and evening concerts by famous military bands, and special spectacular effects, all of which will be open to the general public. Mr. Clarence E. Stump has been appointed General Manager of the exhibition.

London *Truth* says that the following notice is stuck up in all the tramway cars of Belfast, Ireland:

The habit of spitting in a public conveyance is a filthy one, and renders the person so offending subject to the disgust and loathing of his fellow-passengers.

Commenting on this the New York *Evening Post* says: "Now, why cannot the Manhattan Elevated and the Metropolitan Traction Companies stick up something of the same sort in large type in their cars? It would offend no one and it would probably stop the spitting of large numbers who have never before heard any objection to it."

We say amen to the *Post's* suggestion and will go still farther and recommend that such a notice should be conspicuously posted in every station and railroad car for the conveyance of passengers in the country. Colonel Hain is disposed to be a reformer and a public benefactor. He could earn the everlasting gratitude of all the ladies who travel on his road, if he would adopt the *Post's* proposal and thus lessen the unspeakably nauseous, execrable, offensive, odious, loathsome, horrible, hateful, detestable, foul, unwholesome, beastly, and infectious practice of expectorating in public places. "We" are not a woman nor the husband of one, and therefore can perhaps only faintly realize the disgust to which they must be subjected by having their skirts soiled from the pollution of public conveyances by those who convert them into swineries. Perhaps we ought to apologize to the pigs for the latter comparison, as we never heard of a hog spitting, excepting one of the human kind.

Since the above was written the "pathologist" of the Board of Health of New York presented to that body a report on the spitting habit and its danger to public health. In this report it is said:

"We desire to direct your attention anew to the continual transmission of infectious disease in public places, through the expectoration of persons suffering with different forms of infectious diseases of the throat and lungs."

The adoption of the following among other resolutions is recommended:

WHEREAS, spitting in public places constitutes a public nuisance; therefore be it

Resolved, That notices be posted in all public places and in all surface and elevated cars in this city, signed by the Board of Health, warning passengers against expectoration upon the floors of these conveyances; and, further, that similar notices be posted in the stations of the elevated roads, warning against expectoration upon the platforms and stairs or on the floors of the stations.

Resolved, That similar notices be posted in the halls and assembly rooms of all municipal and federal buildings in the city.

Resolved, That the municipal authorities be requested to provide sufficient and proper receptacles for expectoration for such public places as are in their control, and that the managers of the elevated roads be required to provide similar receptacles sufficient in number for their stations and platforms, and that in all cases these receptacles shall be kept in a cleanly condition.

Resolved, That the officers of the Manhattan Elevated Road be requested to give peremptory orders to their guards to refrain from and to prevent, as far as is possible, expectoration from the trains into the streets, and to secure the enforcement of these orders.

The editor of this paper regrets that the practice of chewing gum was not included in the animadversions of our friend the pathologist.

LARGE LOCOMOTIVE GRATES VERSUS SMALL ONES.

At the October meeting of the Western Railroad Club a paper, by Mr. J. Snowden Bell, on Wide Firebox Locomotive Boilers, was read and was afterward discussed at the November meeting. The paper was largely historical in its character, and described the different forms of wide fireboxes which have been introduced during the past 50 years. Considering the fact that various forms of large fireboxes have been in use for so long a time it is somewhat remarkable that such elementary propositions as the relative merits of large and small grates should still be the main topic of discussion, when this subject is brought before an up-to-date association like the Western Railroad Club. In fact the discussion was by no means conclusive with reference to the primary question whether a large locomotive grate and firebox is better than a small one. In fact this debate reminds one of a boy's composition on the seasons, in which he said that "some loves Spring, some loves Summer, others Autumn and others Winter; but as for me give me Liberty or give me Death." That is, the participants in the discussion seemed to desire most to maintain a non-committal attitude: with reference to the question under consideration, so as to be free to use big or little fireboxes as they might choose. Now, in this as in a great many other instances in life, we must be governed by the necessities and not the utilities which control the problem. In locomotive practice a prime necessity which transcends all others—excepting perhaps that of safety to life and limb—is that a locomotive should generate enough steam to meet the maximum demands of its service. That is it must make steam enough to be able to pull the train, or make time, up the ruling grade in good and bad weather. Nearly or quite everything else must be sacrificed to this necessity. Economy is almost entirely subordinate to it. As a corollary to this the inference may be drawn that grates should be big enough to burn as much coal as is required to meet the demand of steam at such critical times. If the grate is smaller than this it will limit or reduce the capacity of the locomotive, and to do so will be more costly than to waste coal. In other words, the minimum size of the grate is limited by the maximum capacity of the engine.

On the other hand, more than forty years ago D. K. Clark, in his treatise on Railway Machinery, enunciated the principle that "the larger the grate the smaller is the economical consumption, *even with the same heating surface,* showing that the economic value of heating surface is reduced by increasing the grate." From this he drew the inference that "there may be too much grate-area for economical evaporation, but there cannot be too little, so long as the required rate of combustion does not exceed the limits to be afterward defined." Again, as though to emphasize this principle, he says: "The maximum economical hourly consumption increases directly as the grate-area is reduced, even with the same heating surface; showing that *the economic value of heating surface is increased by reducing the grate,** and that by this simple expedient, the same heating surface can economically evaporate larger quantities of water per hour." Again the same author says: "As the economic value of heating surface depends so much on the grate-area, being less as the area is greater, *the grate should be kept as small as is consistent with the demands for steam,** and the practicable rate of combustion." A discussion by the Western Railroad Club—or better still by the Master Mechanics' Association—of these principles, enunciated by Clark so long ago, would now be very interesting. Are they true or is there any doubt about them? If there is it would be of the utmost importance to railroad companies that the true principle with reference to the proportions of locomotive grates and fireboxes should be ascertained, which could be readily done through a series of not expensive experiments if made by an intelligent person. Unfortunately most of our railroad managers seem to be wedded, or at least in love, with ignorance. They are always ready to spend any amount of money in contention or litigation, to protect themselves and advance their interests, but if it could be known, it is believed that the amount of money which is expended annually for the advancement of knowledge is very small.

In the discussion of the paper Mr. Barnes asserted somewhat confidently that "the experiments made on ocean steamers show so conclusively that a high rate of combustion is accompanied by loss in efficiency, that it does not seem that any one conversant with the facts could dispute the value of a large grate." Again, he said, "We have a great many experiments on locomotives in this country which show conclusively that locomotive boilers with large grates are more efficient than those with small grates, when boilers of equal shell diameter are doing the same work." This statement is just the reverse of Calrk's conclusions. Which is right? Continuing the discussion, Mr. Barnes said: "A strong draft reduces the efficiency when a boiler is so much forced as locomotive boilers are. In stationary boilers, when the draft is very light, an increase of the draft sometimes brings greater efficiency; but when the draft is increased to anything like locomotive draft a farther increase brings less." He said further that what he "wished to emphasize is that, when fuel used per square foot of grate per hour is more than 150 pounds, the use of a larger grate will give a substantial saving." This leads to the query, "What is the most economical rate of combustion?" The maximum now is about 200. When that rate is attained the mean would probably be about 100. If now we could ascertain the most economical rate, would it be best to adopt it as a maximum, or an average rate of combustion? It may be that while a rate of 200 pounds per square foot per hour is wasteful, when the engine is working at its maximum capacity, that a grate proportioned for that rate working under such conditions would give the most economical *average* results.

Mr. Barnes could do no better service than to collate the experiments bearing upon this question and then analyze them and indicate their significance. Probably his confidence in the soundness of the propositions he enunciated would be a little shaken if all the evidence was collected and carefully weighed. It may be remarked incidentally that the interesting experiments which were made by John E. Martin in Chili, a report of which is published in the Proceedings of the Master Mechanics' Association for 1878, sustains Clark's views. Away back in the fifties Ross Winans was building his Camel engines with what were then considered very long and wide fireboxes for the Baltimore & Ohio Railroad. Samuel J. Hayes was then Master of Machinery and designed some ten-wheeled engines with fireboxes as wide as he could get between the wheels and rise flat slab frames on their sides. The grates were not as long as Winans' and part of them were covered with dead-plates. In a test of fuel consumption Hayes' engines beat Winans', and the latter then resorted to the use of dead-plates and obtained better results. Afterward, when Hayes became the Superintendent of Machinery of the Illinois Central Railroad, he equipped nearly all the Rogers and other engines in that line with what were called hopper grates; that is, there were inclined dead-plates in the sides and in the back, and the drop-door in front was also dead. These grates produced very good results with the inferior Illinois coal. When Mr. Wootten first tried one of his fireboxes for burning bituminous coal he left the whole immense grate open, but soon discovered that he could produce better results by covering part of it with firebrick.

There seems to be a good deal of evidence to sustain the principle enunciated by Clark, that the smaller the grate, provided enough coal can be burned in it, the greater the economy. Of course a rate of consumption of coal may be reached, with a powerful blast, at which much of the fuel is not burned but is lifted mechanically from the fire carried through the tubes and up the chimney. That such a rate is not economical need hardly be proved, but such a maximum rate of consumption may be required in order to have the most economical average rate when the locomotive is not working the hardest.

Investigation and experiment would probably show that some given rate of combustion per square foot of grate per hour is the most economical, or possibly that different rates are desirable according to whether the locomotive is

*The italics are ours.

working hard or not. From this the inference may be drawn, that the open grate should be larger when the engine is doing its maximum work, than it is during an average or minimum exertion of power. In other words to produce the best results the area of open grate should be variable, to meet the requirements of the work to be done.

But in the consideration of the size of fireboxes and grates the fact is often lost sight of that there are really two questions involved, one concerning the area of the grate, and the other that of the volume or contents of the firebox, and that a *large* firebox may be used with a *small* grate, and if it can be shown, as Clark enunciated, that small grates are more economical than large ones, it does not follow that the fireboxes should also be small. A big fire box in combination with a small grate may be, and probably is more economical than a small firebox would be. There can be no doubt that the process of combustion occupies an appreciable amount of time, and it is also true that, with a powerful blast and a small firebox, that the movement of the air and gases in the firebox and tubes is very rapid. Probably when an ordinary locomotive is working hard not less than 250 cubic feet of air and gas is exhausted from the firebox in a second. As the cubical content of an ordinary locomotive furnace is only about half that volume, the air and gases in it must be changed twice during each second, so that whatever combustion occurs, must take place in half a second. If the size or volume of the firebox was doubled the air and gases would remain in it twice as long, and, conversely, there would be twice as much time for combustion to take place. It seems evident that under these conditions, better combustion would result than can be secured when less time is given for it to take place. The inference may then be drawn that the larger the firebox the more likely we are to secure good combustion, and if D. K. Clark is right about grates we must come to the apparently contradictory conclusion that the smaller the grate and the larger the firebox the better will the combustion be.

But there is another principle involved. Frederick Siemens long ago pointed out that as soon as flame comes in contact with any solid substance combustion is at once retarded, and it begins to smoke. This may be shown by holding a metal or glass rod in the flame of an ordinary gaslight. Siemens' inference from this was, that in all kinds of furnaces we should aim to keep the flame away from the sides and top as long as possible, or until the process of combustion is completed. This principle has been observed in the construction of ordinary egg-shaped stoves for burning bituminous coal and in foundry cupolas and blast furnaces, in all of which there is a small grate at the bottom and the sides then swell out above so as to be away from the flame as it rises from the fuel. Owing to the construction of ordinary locomotive fireboxes, and the limits to which they are confined, this principle could not be adopted and the sides are so placed—especially in those which are very narrow—that the flame comes in direct contact with the plates, which have water on the opposite side of them. By the use of wide fireboxes and contracted grates, the contact of the flame would not be so immediate nor direct as it necessarily must be with a narrow furnace. The ideal form for a firebox would be a hollow sphere, a form which has the least area of enclosing surfaces, in proportion to the internal space of any other. A sphere, however, would not be a convenient form for a firebox. If it is to be rectangular, a cube would have the least surface area of any other form, or in other words the nearer the width, length and height are to being alike the better.

If the preceding reasoning is sound, we will have the conclusion that the smaller the area of the open grate of a locomotive, provided enough coal can be burned on it, the greater the economy, and the larger and more nearly alike all the dimensions—that is its length, breadth and height, —of a firebox are the better. Now these propositions are of very great importance to railroad companies. At present they are to a considerable extent merely tentative, and to be entirely convincing some experimental demonstration is required. It is believed that it would be immensely profitable to railroad companies if the required experimental investigation was made by some competent person to prove the soundness of these conclusions. Who will undertake to have it done?

Trade Catalogues.

[In 1894 the Master Car-Builders' Association, for convenience in the filing and preservation of pamphlets, catalogues, specifications, etc., adopted a number of standard sizes. These are given here in order that the size of the publications of this kind, which are noticed under this head, may be compared with the standards, and it may be known whether they conform thereto.

It seems very desirable that all trade catalogues published should conform to the standard sizes adopted by the Master Car-Builders' Association, and therefore in noticing catalogues hereafter it will be stated in brackets whether they are or are not of one of the standard sizes.]

STANDARDS.

For postal-card circulars	3½ inches by 6¼ inches.
Pamphlets and trade catalogues	3½ inches by 6 inches. 6 inches by 9 inches. 9 inches by 12 inches.
Specifications and letter-paper	8½ inches by 10¾ inches.

COMPUTERS PUBLISHED BY COX COMPUTER COMPANY, 178 Greenwich street, New York.

This is a circular describing several kinds of "computers" which consist of circular card discs arranged to revolve in a foundation plate and with printed scales corresponding to the various factors of the formula. In the circular before us computers for pulleys and gearing, belting and shafting are described. The company makes some 30 others for various purposes which they propose to furnish for advertising and other purposes.

A THIRD OF A CENTURY OF PROGRESS. Being a Brief History of the Development of the B. F. Sturtevant Company, Boston, Mass, 36 pages, 5 by 6½ inches. (Not standard size).

The title of this little publication describes its character accurately. It is a brief history of the company, illustrated first by a portrait of Mr. Sturtevant, the founder of the company, and further on with one of Mr. Foss, the present General Manager. Several views of the works as they appeared at different periods are also given, some of them made from excellent wash drawings. There are also scattered through the "history" small engravings representing various machines made by the company, but which are hardly worthy of very high commendation. The little volume gives, however, an excellent idea of the wonderful progress of the establishment, which was started by a young shoemaker within the recollection of many of us who are no longer young. The pamphlet is admirably printed on excellent paper.

THE NEWTON MACHINE TOOL WORKS, of Philadelphia, announce that they have removed to their new works at Twenty-fourth and Vine streets, and send a circular giving internal and external views of their new works and small illustrations showing the various kinds of machinists' tools which they manufacture.

THE NATIONAL MALLEABLE CASTINGS COMPANY, OF CLEVELAND, O. 113 pages, 9 by 12 inches. Standard size.

This latest catalogue of the company serves as a striking object lesson of the extent to which malleable iron is applied in car construction. The whole 113 pages are filled with well executed half-tone engravings in vignette illustrating the various articles for which the company has patterns. Each article is given a number and beneath it is printed a short description giving dimensions, etc., that may be of value to the purchaser. The last pages are occupied by a very complete index, so that any article can be easily found. The book is printed on heavy calendered paper, and is an example of fine presswork. Among the special articles to which attention is called are the Tower coupler, the National car-door fastener, center plate, journal box and journal box lid, the Eubank car door and fixtures, and Coffin's carline and sill pockets. For the rest the work includes pretty much all the metal work of a car.

THE NEW BRITAIN MACHINE COMPANY. *Manufacturers of Chain Saw Mortisers, Case Engines, etc.* New Britain, Conn. 12 pages, 6 by 9 inches. (Standard size.)

Probably a good many readers will be disposed to ask what a "chain saw mortiser" is? In reply it may be said that it is a wood-working machine in which, as described in the catalogue before us.

"The cutting is performed by a steel chain, each link of which has a sharpened tooth so formed as to carry away its own chip, and is presented to the work a thousand times a minute. This will illustrate the possibilities of the machine for rapid work.

"This chain, driven by a sprocket, travels over, and is guided by a chain-bar having an anti-friction bearing at its lower end. The table holding the work is fed automatically up towards the chain, the mortise, either "blind" or "through," is made at a single cut and the table rapidly descends to the starting point ready for another mortise so quickly as to almost limit the machine's output by the ability of the operator to supply it with work. Under ordinary circumstances, from 400 to 500 four panel doors should be put through in ten hours (each door having ten accurate, clean mortises), and other work in proportion, depending on the size of mortise and hardness of stock."

The machine is illustrated with very good wood engravings and its advantages are fully set forth. The chain which does the mortising is shown by a separate engraving, in its relations to a mortise in a wooden beam.

The Case steam engine is also illustrated, which is a self-contained vertical engine. It would be much more satisfactory if a sectional view showing the internal construction of this engine was given. It is announced in a slip enclosed with the catalogue that Mr. Sidney B. Whiteside, of 139 Liberty street, New York, is the selling agent for this company.

CATALOGUE NO. 4. THE WEIR FROG COMPANY, MANUFACTURERS OF FROGS, SWITCHES AND CROSSINGS. Cincinnati, O. 273 pages, 4½ by 8½ inches. (Not standard size.)

This is another example of the many admirable catalogues which are now issued by our manufacturers of railroad material and appliances. The only faults which we can find with it is that it is not a standard size, and the other is that its usefulness would have been much increased if somewhat fuller elementary explanations had been given of the construction and appliances illustrated. That which is given is, however, so good that—like poor Oliver, in Dickens' immortal story—we are inclined to "ask for more."

The book opens with a sort of invocation to the "patrons" of the company, which is followed with "instructions for ordering material."

Frogs are the first structures which are illustrated and described, the opening portion of this department being an explanation of the methods heretofore employed for constructing frog-points and that now adopted by this company. A large number of frogs for various purposes and localities are then illustrated with excellent wax-process engravings showing plan and sectional views of the frogs. The second portion is devoted to crossings, which are similarly illustrated. This is followed by a chapter on switches, in which the various types are illustrated and described, and this is supplemented with descriptions of switch stands which are represented by some excellent wood engravings. Chairs, rail-braces bridge-guards, station signals, derailing switches, frogs and switches for light rails are all described and illustrated. Street railway track work has a separate department devoted to it, in which nearly all the appliances enumerated above, but which are adapted to that kind of service are shown and explained.

At the end of the book a series of admirable tables are given relating to track work. These include tables for the leads for turn outs, for crossovers, bills for crossties for turnouts, crossovers and crossings of various kinds, several giving the number of feet (board measure) in cross-ties, others in which the quantities of rails, angle-bars, spikes fish-plates and bolts required per mile of track are given. There are also tables of middle ordinates in inches for curving rails, decimal parts of an inch and a foot for sixty-fourth of an inch, and a list of the weight and size of rail sections carried in stock by the Weir Frog Company.

The book is printed on good wood-pulp paper, is well bound and of convenient size and form, and is altogether worthy of commendation excepting that it is not of standard size.

MORISON SUSPENSION FURNACES FOR STATIONARY BOILERS. *Manufactured by the Continental Iron Works.* Brooklyn, N. Y. 25 pages, 9 by 11 inches. (Not standard size.)

The chief purpose of this publication is to describe corrugated iron furnaces, and set forth their advantages. The book opens with an excellent perspective view, made from a wash drawing of the Continental Iron Works. There is then a very good dissertation on internal furnace tubular boilers, with references to some excellent line engravings, showing sectional and other views of a "Scotch," a "Locomotive," or "Gun Boat" boiler provided with the internal corrugated furnaces. The relative advantages of such boilers compared with those of the water-tube type are discussed, and the arguments in favor of the "suspension furnaces" are fully set forth.

Half tone perspective views are given of a boiler of 125 horse-power with a single furnace, in use at the Eighteenth street station of the Consolidated Gas Company, in New York, and another of a battery of five similar boilers now at the Milburn Pumping Station of the Brooklyn City Water Works. There is also a full sized sectional view showing the form of the corrugations, and tables giving the working pressure and thickness of the Morison furnaces, and another table showing the method of calculating the power rating of internal furnace boilers.

The Morison patent furnace door is also a specialty of manufacture by this company, and is illustrated and described at the end of the Continental Company's very neat catalogue, the cover of which may be especially commanded for its very simple and pleasing design.

American Machinist.

In the first number of this year it is announced, in this widely-known journal, that the control of the paper has passed into the hands of Messrs. Sinclair & Hill, the proprietors of *Locomotive Engineering*. The form and size of it has been changed, and those who have been familiar with the appearance of the old paper will be obliged to become acquainted with their former friend in a new dress. Whether the dignity of the old paper is to be maintained or the style which has been characteristic of *Locomotive Engineering*, and which appears to be popular, is to be adopted in both is not yet apparent.

Circular of Inquiry on Freight-Car Doors and Attachments.

The following circular has been issued by the committee of the Master Car Builders' Association:

Your committee, appointed to report on the latest improvements and best practice in freight-car doors and attachments, requests that you will co-operate by replying as promptly as possible to the questions given below:

1. Give your experience and the results obtained from the use of the different freight-car doors in use on your road.
2. What style of door do you prefer—the overhead hung, the bottom hung, or other style hung door, and why?
3. What style of door or doors are standard on your line, and what are their advantages over other doors?

Please furnish blue prints, sketch or full description of your standard door or doors, including end doors and attachments, covering the following detail:

A. Size of doors and style of construction.
B. Style of hangers used.
C. Style and shape of rail and size of same.
D. Method of securing rail to body of car.
E. Locks and their attachments and method of application.
F. Stops, both front and back.
G. Brackets at bottom of door, including common brackets and special safety brackets, to prevent opening of door without breaking of seal.
H. Wedges, shoes, etc., used on bottom of door.
I. Description of any peculiar construction of bottom of door where it runs into brackets or on rail.
J. Description and name of any patent device in use in connection with door hangings or fastenings, not brought out by preceding questions.

Please forward replies to F. H. Soule, General Car Inspector, N. Y., N. H. & H. R. R., New Haven, Conn., before February 20, 1896.

Personal.

Mr. Clarence F. Barker has been elected General Manager of the Cairo Short Line.

Mr. H. C. Landon has been appointed Chief Engineer of the Chicago, Peoria & St. Louis.

Mr. John D. Campbell has resigned as Master Mechanic of the Buffalo & Susquehanna Railroad.

Mr. Remsen Crawford, of Atlanta, Ga., has been appointed press agent for the Plant system.

Mr. J. C. Hennessey, Superintendent of the Missouri Pacific Terminals at Kansas City, has resigned.

Mr. W. C. Brown has been appointed General Manager of the Chicago, Burlington & Quincy Railroad.

Mr. H. A. Riggs, Chief Engineer of the Toledo, Ann Arbor & North Michigan Railroad, has resigned.

Mr. La Mott Ames, who has been Master Mechanic of the Beech Creek Railroad for a number of years, has resigned.

Mr. A. H. Thorpe has been appointed assistant to the General Manager and Purchasing Agent of the Ohio River Railroad.

Mr. F. C. Gates is acting as Purchasing Agent of the Wheeling & Lake Erie Railroad during the illness of Mr. F. S. Deal.

Mr. Samuel Irwin, Superintendent of the Car Department of the Missouri, Kansas & Texas Railroad, died Jan. 5, of apoplexy, at Sedalia, Mo.

Mr. John Warwich has been appointed Purchasing Agent of the railroads comprising the Seaboard Air Line, with headquarters at Portsmouth, Va.

Mr. A. H. McLeod, formerly General Freight Agent of the Cincinnati, Hamilton & Dayton Railroad, has been appointed Traffic Manager of that road.

Mr. Thomas Orchard, Master Car Builder in charge of the Carbondale, Pa., shops of the Delaware & Hudson Canal Co., died recently at the age of 76 years.

Mr. George W. Parker, President and General Manager of the St. Louis, Alton & Terre Haute Railroad, has resigned the latter office and retired from active service.

Mr. Seeley D. Dunn has been appointed Superintendent of the Owensboro & Nashville Division of the Louisville & Nashville Railroad, with headquarters at Russelville, Ky.

Mr. F. J. Cole, formerly Mechanical Engineer of the Baltimore & Ohio Railroad, has resigned and accepted the position of Chief Draughtsman with the Rogers Locomotive Company.

Mr. W. A. Garrett, Superintendent of the Terminal Association of St. Louis, has resigned in order to take the position of Superintendent of the Western division of the Wabash Railroad.

Mr. A. M. Tucker, formerly General Manager of the New York, Pennsylvania & Ohio Railroad and its leased lines, has been appointed General Agent of the New Erie Railroad Company, with headquarters at Clevelavd, O.

Mr. H. Delaney has been appointed Master Mechanic on the Philadelphia & Reading Railroad. His office will be Third and Berks streets, in Philadelphia, and he is to have charge of the Philadelphia and New York Division.

Mr. L. R. Pomeroy, who was recently of the firm of Coolbaugh & Pomeroy, announces that he has been appointed sales agent for the Cambria Iron Company and the Latrobe Steel Company, with an office at 33 Wall street, New York.

Mr. Carl W. McKinney, General Manager of the Lackawanna Iron and Steel Company, has resigned on account of ill health. He will be succeeded by Mr. Henry J. Wehman, the present General Superintendent and Chief Engineer of the company.

Mr. Andrew F. Burleigh has been made sole receiver for the Northern Pacific Railroad by Judge Gilbert, of the United States Court at Portland. Judge Gilbert said a change was necessary, not for any personal reason concerning present receivers, but for more harmonious management of the road.

Mr. William Duncan, Traffic Manager of the Baltimore & Ohio Southwestern, has resigned that position, to take effect on Feb. 1. Mr. Duncan has been in active railway service for nearly 30 years, and will retire from railway work, but will become President of the Ludlow & Saylor Wire Company, of St. Louis, Mo., a concern in which he is largely interested.

Mr. Stephen C. Mason, Assistant Statistician of the Interstate Commerce Commission, has resigned to accept a responsible position with the McConway & Torley Company, of Pittsburgh, Pa. Mr. Mason has been connected with the Commission over eight years, and for the last three years in direct charge of the statistical division and of the compilation of the statistical reports published by the Commission.

Mr. Thomas Prosser, Sr., for more than 40 years a member of the firm of Thomas Prosser & Son, the American representative of the Krupp works in Germany, died on Jan. 10, at his home in Brooklyn, after a long illness. It is nearly a year since he has been engaged in active work. He was born in Worcester, England, 67 years ago and came to this county with his parents when he was nine years old. His father was engaged in the steel business in Paterson, N. J. In 1851 the father organized the firm of Thomas Prosser & Son, and commenced business in Platt street, near Gold, New York. While at the International Exposition in London in 1852 he met Herr Krupp, the founder of the Krupp works, with whom he formed a lasting friendship. He became the American representative of this firm and the business relations thus established have continued uninterruptedly to the present time. Thomas Prosser & Son have dealt mainly with railroads, steamship companies and machinery manufacturers. It is expected that Mr. Thomas Prosser, who has been connected with the firm for a number of years, will succeed his father as the head of the house.

Mr. Alfred E. Beach, who has been one of the editors and proprietors of the *Scientific American* for nearly fifty years, died on Jan. 1, at the age of 70, at his home in New York. He was the son of Moses J. Beach, the founder of the New York *Sun*, but, with the exception of a short period passed in his father's office, his entire business life has been spent as a member of the firm of Munn & Co., the solicitors of patents, which he established in 1846 with A. D. Munn. His firm bought the *Scientific American* and Mr. Beach became its editor, having been responsible for this department during all of these years. Outside of his work in the firm as a patent solicitor and editor, he devoted a considerable portion of his time to the development of his own mechanical ideas, and the list of his inventions is an important one. As early as 1852 he exhibited a type writing machine at the Crystal Palace Exhibition in New York, for which he received a gold medal. It had practically all of the devices of the typewriting machines of to-day. He devised a pneumatic tube system for carrying the mails and a pnematic railroad, of which an elevated experimental section was built. The Beach Pneumatic Transit Company, of which Mr. Beach was President, built a section of underground road beneath Broadway in 1869. This section was built without interfering with the street traffic by the Beach hydraulic shield, the parent of those used at the St. Clair tunnel, on the City & South London Underground Railroad, and elsewhere.

Queen Victoria's Cars.

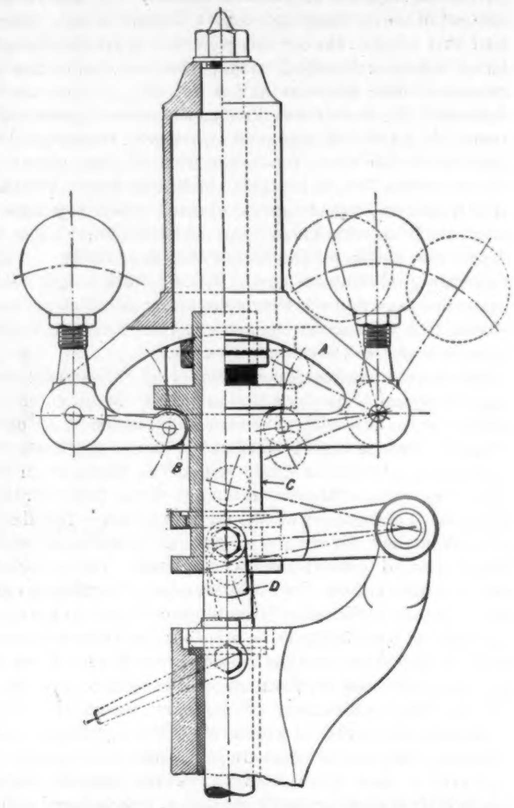
The official *Railway Gazette* states that the two railway carriages which the queen uses on her continental journeys were built for Her Majesty in Belgium, and they are her own private property. They are kept, when not in use, at Brussels, at the Gare du Nord, and have just been thoroughly overhauled and renovated. They are always carefully covered up to preserve them from injury. The day saloon is furnished with two sofas, two armchairs, one large footstool, all covered with blue silk, with yellow fringe and tassels. The walls are hung with blue silk for the dado, and pearl gray above, brocaded in pale yellow with the rose, shamrock and thistle. The curtains are blue and white, and a dark Indian carpet covers the floor. There is a large center table and two small ones. The ventilator in the center of the ceiling is of cut glass, and there are four lights in the ceiling. The carriage is lighted at night by four oil lamps fixed in brackets on the walls while shaded reading lamps are also used. There are electric bells, and one of the Highland attendants travels in a separate small compartment in front of the saloon. A short covered corridor connects the day saloon with the sleeping carriage, which is divided into a suite of small rooms. The dressing room, which is hung in Japanese style, with bamboo on the floor, contains a white metal bath and a washstand stand covered with red morocco leather. All the toilet articles are of the same metal as the bath. The bedroom is decorated in gray and brown. There is a large bed for the queen and a smaller one for Princess Beatrice, both of which were manufactured in the royal stores at Windsor, and all the bedding is bought fresh for each journey, and taken away afterward. There is also a luggage room, in which the two maids sleep on sofas.

A High Speed Belt Governor for Corliss Engines.

The close adjustment to speed that engine builders have been compelled to guarantee for electrical work has brought about a marked improvement in the regulating apparatus of all engines both high and low speed. While the high speed engines have been brought to a very close regulation with comparative ease, the difficulties have been greater with the low, owing to the longer period required for the performance of a complete cycle. In order to obviate this last difficulty, the Lane & Bodley Company of Cincinnati, O., have adopted a high speed governor for the regulation of their Corliss type of engines. This governor is shown in some detail by the accompanying engraving of half elevation and section, and was used on the 22-inch by 48-inch engine that was exhibited by them at the Atlanta Exposition, and whereon the regulation was so close that in the driving of the general electricmonocyclic generator there was never a variation of more than one volt in the generation of a current averaging 107 volts.

This governor is driven by the usual belt and bevel gearing connection, the balls being run at a speed of 196 revolutions per minute. They are carried on a frame A attached to the top of the spindle and are fastened at the end of a bell crank whose horizontal arm carries a roller B bearing on the underside of a shoulder on the sleeve C, which is thus raised as the balls are thrown outward by the centrifugal force due to their rotary motion, and against a spring tending to bring them to the extreme inner position, this spring not being shown in the engraving. The rising and falling of this sleeve regulates the point of cut-off in the usual way.

When the engine is stationary the weight of the sleeve and the pressure of the spring are sufficient to raise the balls and throw them into the inner position, as shown by the dotted lines, in which position steam is entirely cut off, and there would be no admission were the throttle to be



High-Speed Belt Governor for Corliss Engines.

opened. To facilitate starting, the sleeve is slightly raised and the stop D so set that it is blocked up and the starting bar used in the ordinary way. As the engine gathers speed the stop drops out and the sleeve is held in suspension by the action of the balls. But if the governor belt should, at any time, break, fly off, become loose or otherwise inoperative and the balls stop, the sleeve at once drops to the lowest position and cuts off all steam admission to the cylinder.

Thus the rapid motion of the balls enables a close adjustment to speed to be maintained, while any accident to the apparatus itself causes the steam to be shut off and all damage from racing prevented.

A statement that worm gearing, if used for power transmission in electrical works, should be employed only in conjunction with low-speed motors, has brought out a remark from Herr E. Kolben, of the Oerlikon Engineering Works in Germany, that high-speed motors should be adopted in such cases if the best results are to obtained. He points out that a great prejudice against worm gearing has hitherto existed, on account of its having been regarded as an inefficient means of transmission. He believes that much depends upon the construction of the gearing and refers to tests recently carried out by Professor Stodola, of the Zurich Polytechnic, with the ordinary double-thread worm gear of the Oerlikon Engineering Works. The worm was 80 millimeters in diameter, had a multiple-ring bearing, and engaged with a worm wheel having 28 teeth, the wheel being of bronze, 373 millimeters in diameter. The whole of this gear was placed in oil in a cast-iron box. The gear was coupled to a 20 horse-power electric motor and the brake was applied on the worm wheel shaft. At 1,500 revolutions a useful performance of 21 horse-power was given on the brake, the efficiency amounting to 87 per cent. Herr Kolben is of the opinion that the efficiency with the motor fully loaded will increase even beyond 90 per cent., if the speed is high, the worm made of tool steel polished, the worm teeth of bronze, and the friction of the whole mechanism on the starting of motors at full load is reduced by having the pressure taken up by starting disks arranged on both ends of the worm.

The Most Advantageous Dimensions for Locomotive Exhaust-pipes and Smoke-stacks.*

BY INSPECTOR TROSKE.

(*Continued from page* 13.)

II. THE HANOVER EXPERIMENTS (1892-94).

These experiments were suggested by the fact that a newly constructed high-speed locomotive was an exceedingly poor steamer, and that the usual remedies made only a very slight improvement. In order to ascertain the reason for this phenomenon, Herr von Borries, the Superintendent of Motive Power of the State Railways, decided to make a special investigation with different shapes of smokestacks, and had made, for that purpose, the apparatus illustrated by Fig. 12. The author of this paper was intrusted with the execution of these investigations. They were commenced in the summer of 1892 at the main workshops of the railroad company, and continued on until the autumn of 1894.

The apparatus used is shown in Fig. 12. It consists essentially of a lower steam chamber and an upper air chamber. The steam pipe with a diameter of 6.3 in., passed air tight through the plate separating the two chambers and carried the nozzle at its upper end, this piece having an opening ranging from 3.9 in. to 5.5 in. The stacks subjected to the investigation had a diameter of 17.7 in., and were placed over the circular opening cut in the top sheet of the air chamber. On the four sides there were four air valves of the same size. It was the original intention to investigate the effect of various positions of the nozzle relatively to the lower end of the stack, and to do this by raising or lowering the nozzle through the means afforded by the apparatus illustrated in Fig. 12. But it developed that when the nozzle was in its lowest position, the air chamber itself acted as a sort of stack, and it became possible, with the stack removed, to obtain a vacuum equivalent to ¼ in. water pressure.

In order, therefore, to render exact work possible, and for which purpose it became necessary to place a cap over the mouth of the pipe leading from the boiler, the location had to be obtained by more convenient means. The distance of the nozzle in question could then be changed without actually altering the position of the nozzle itself, by changing the position of the stack by putting welded rings in between its foot and the air chamber. These rings were welded out of ½-inch plates, and were of the form shown in Fig. 13. There were 10 of these rings, starting with one 1.57 inch in height and increasing in height by 1.57 inch. By setting several rings on top of one another, the distance of the nozzle from the lower end of the stack could be increased up to 30 inches or more.

During the tests the joints between the rings were well packed with wicking, so that they were kept air tight. The four air valves were so adjusted for the admission of the outer air that their combined free area amounted to 14.65 inches by 5.51 inches equals 80.72 square inches. This latter had previously been determined on a standard passenger locomotive in the following manner: After loosening the slide valve and then fastening in another in such a way that the steam ports were closed, a mercury manometer was connected with the empty steam chest of the locomotive and then enough steam was admitted through the throttle valve, the depth of the fire being the same as that ordinarily carried on fast runs, to produce a vacuum of 3.94 inches of water in the smoke-box as indicated by the water column attached thereto. The corresponding readings of the mercury manometer that measured the steam pressure were noted, and this was repeated several times until a whole series of results was obtained, and then an average was taken. Then a blast nozzle of the same size as that used upon the locomotive was placed upon the apparatus and steam admitted until the mercury manometer indicated the average pressure that had been obtained by the previous experiments, when the air valves were so adjusted, the same amount of opening being left in each, that the vacuum indicated by the water column amounted to 3.94 inches. This was then made the basis of the experiments which were thus warranted to correspond closely to actual practice. As a matter of fact also, as we have already remarked, the different shapes of stacks that were investigated with the valves in these positions were frequently transferred afterward to locomotives under steam and made fast, where precisely the same results were obtained. In consequence of the uniformity of results the slight difference which existed between the steam measurements in the steam-chest and the apparatus due to the greater freedom of steam flow in the latter seems to be a matter of no moment.

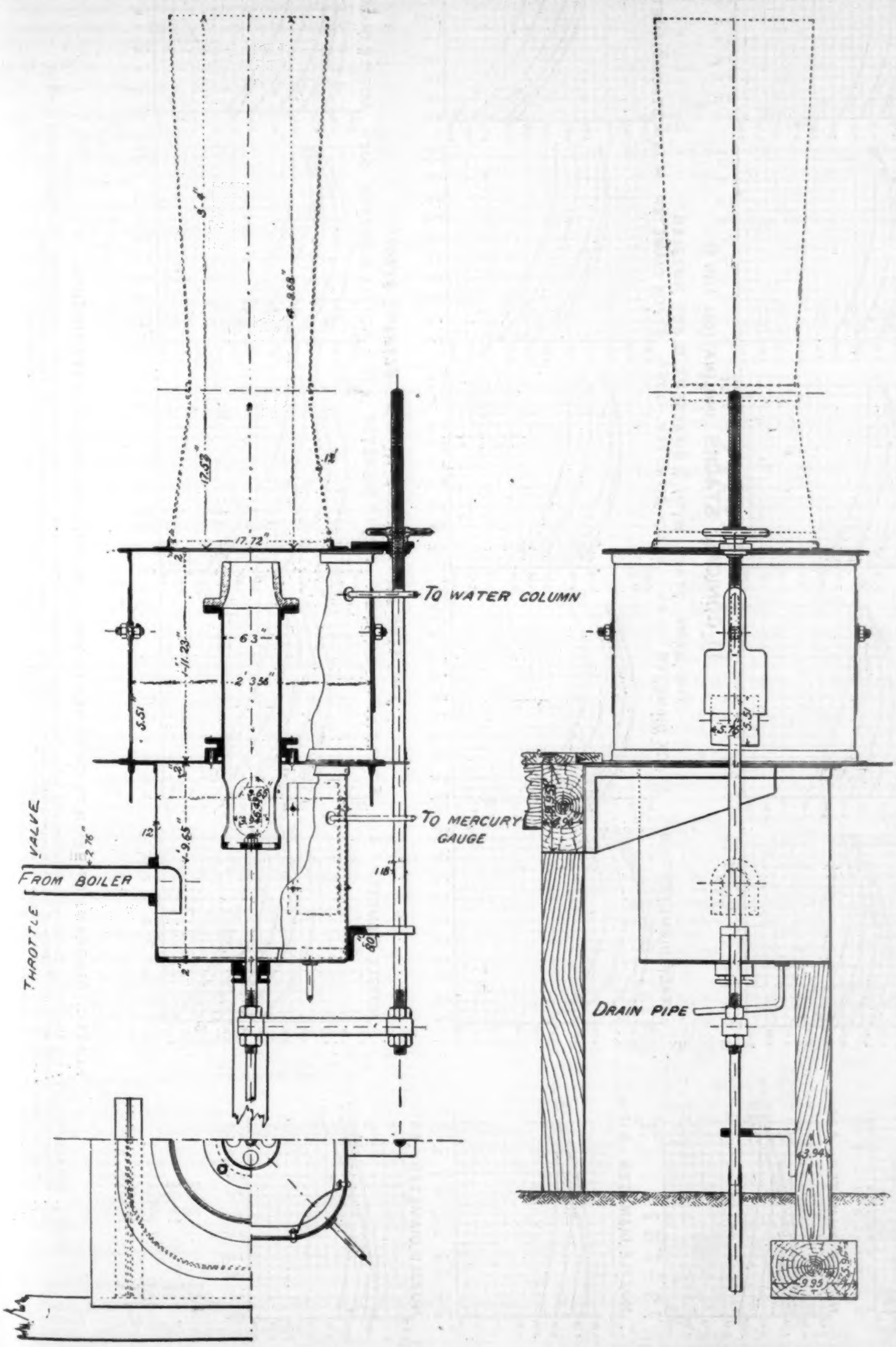


Fig. 12.—Apparatus Used in the Hanover Smoke-Stack Experiments.

The position of the four air valves being thus ascertained,

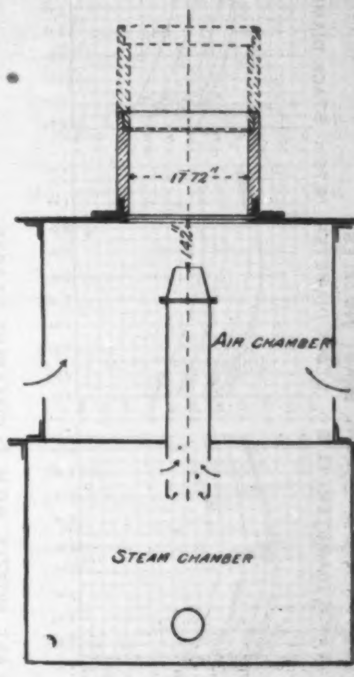


Fig. 13.

the experiments were then carried on, admitting cold air into the chamber, while in the actual work of a locomotive it is well known that the temperature of the hot gases coming from the firebox range from 575 degrees to 840 degrees Fahrenheit. Afterward similar experiments upon a running locomotive showed that the difference between the same shaped current of steam as applied in the apparatus or upon the standing locomotive and the steam acting intermittently upon a fast-running locomotive is of no importance whatever, as far as the action of the stack is concerned, and though this is not the case with slow-moving locomotives, it is in no way troublesome to make a transfer or application of the results obtained with the experimental apparatus. It has already been stated here that isolated experiments with the apparatus in no way serve to establish the formula for the laws of actual service, but that these can only be fixed by experiments with running locomotives.

The next thing to establish was how smokestacks of different forms would act with respect to the creation of the draft. Here it is a matter of slight importance whether the values of the vacuum obtained are in exact correspondence with the values observed on running locomotives or not.

In all the experiments with the apparatus the aforesaid positions of the air valves were left unchanged, hence the sucking action of the steam current could not be clearly shown for the different relationships, but only on locomotives of prescribed limitations. Moreover, though the experiments had already occupied so much time for the establishment of this basis, and though it was necessary for them to be carried on at spare intervals, it was very evident that they must be extended still further in order to investigate the effects of varying the size of the air openings. These experiments were made with blast nozzles of five different diameters and 18 different smoke-stacks taken from locomotives of ordinary proportions. The dimensions and shapes were:

Fig. 14.

(*a*) Five different blast nozzles of 3.94 inches, 4.33 inches, 4.74 inches, 5.12 inches and 5.51 inches in diameter, as shown in Fig. 14.

(*b*) Five cylindrical stacks of 13.78 inches, 14.76 inches, 15.75 inches, 16.73 inches and 17.72 inches in diameter, as shown in Fig. 15.

(*c*) Conical-shaped stacks with converging to and bottom inclinations of $\frac{1}{12}$* and minimum diameters of .81 pinches, 12.8 inches, 13.78 inches, 14.76 inches and 15.75 inches, as shown in Fig. 16.

* Paper read before the German Society of Mechanical Engineers.

* By "inclination" the inclination of the two sides of the cone is meant; each side naturally has, therefore, but one half the above-stated inclination to the vertical. If the inclination of the stack is considered to be n, then one side of the cone will be $\frac{n}{2}$; if the length of the stack be considered to be equal to l, then the upper diameter of the stack will be $\frac{l}{n}$ greater than the smallest diameter. For example, if we have a stack 3 feet 6 inches long, with an inclination of $\frac{1}{12}$, we have an increase of diameter of $\frac{42}{12}$ = 3½ inches, or with an inclination of $\frac{1}{6}$, an increase of $\frac{42}{6}$ = 7 inches, etc.

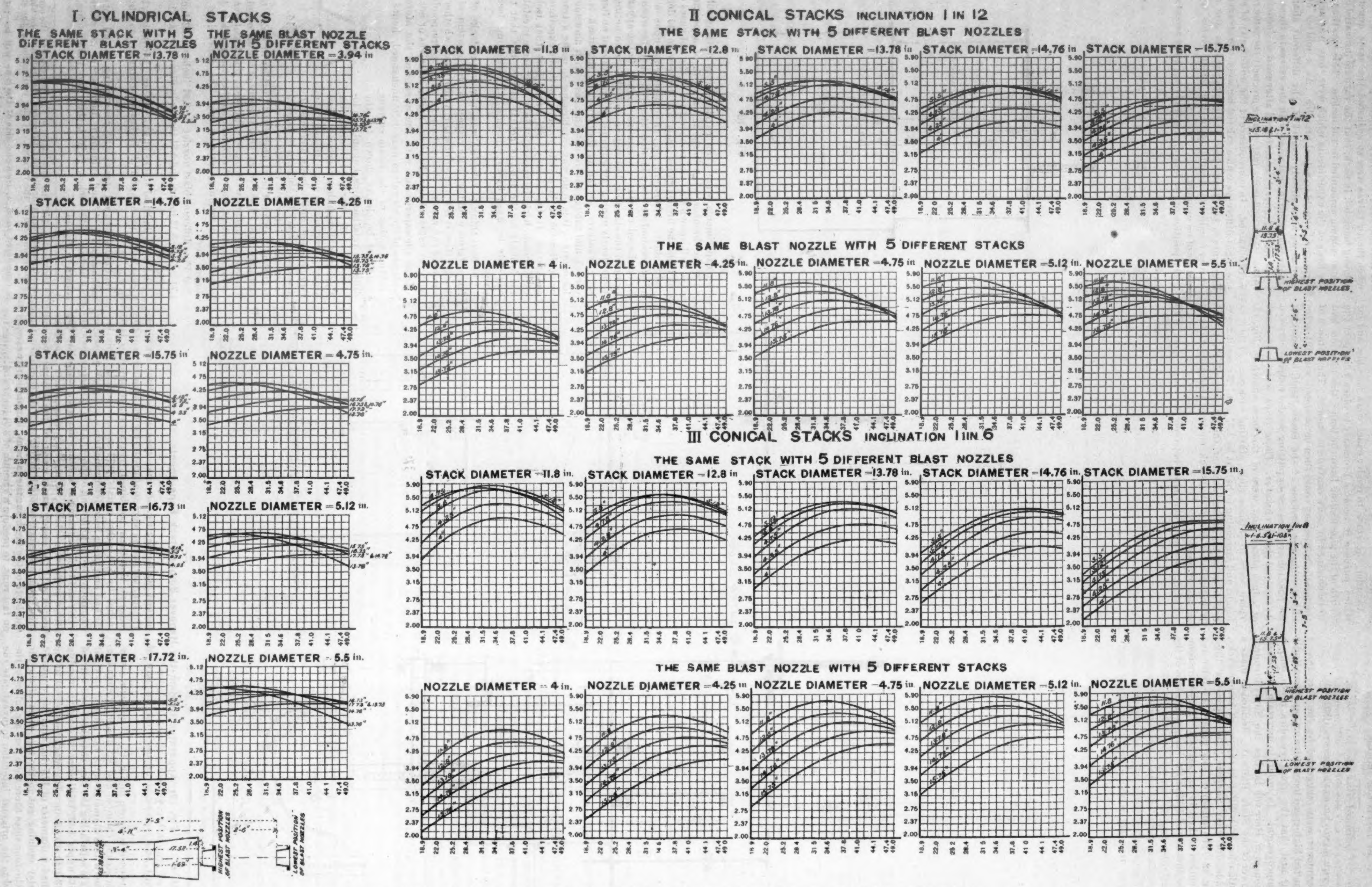


PLATE I.—DIAGRAMS OF RESULTS OBTAINED IN THE HANOVER SMOKESTACK EXPERIMENTS.

NOTE 1. The abscissas give the distance of the top of the blast nozzle below the smallest diameter of the stack; the ordinates denote the corresponding vacuum in inches of water.
2. The curves are plotted from an average of the values obtained, and they vary from the maxima and minima observed by from .02 inch to .08 inch.
3. All of the observations were made with the same steam pressure (3.94 inches of mercury) and with the same opening for the admission of air.
4. The figures at the right hand end of each curve are the diameters of the corresponding blast nozzle or stack.

GENERAL DIMENSIONS OF THE VARIOUS CLASSES OF LOCOMOTIVES ON THE GRAND TRUNK RAILWAY.

Class of engine	No. 39 double ender with side and back tanks 17 in. × 22 in. × 5 ft. 2 in.	No. 82 express, 18 in. × 24 in. × 6 ft. 1⅝ in.	No. 98 express, 18 in. × 26 in. × 6 ft. 6 in.	No. 196 light passenger, 17 in. × 22 in. × 5 ft. 2 in.	No. 326 compound mogul ("H. I." system), 19 in. and 29 in. × 26 in. × 5 ft. 2 in.	No. 572 simple mogul 18 in. × 26 in. × 5 ft. 2 in.
Gage	4 ft. 8½ in.	4 ft. 8½ in.	4 ft. 8½ in.	4 ft. 8½ in.	4 ft. 8½ in.	4 ft. 8½ in.
Kind of fuel used	Bituminous.	Bituminous.	Bituminous.	Bituminous.	Bituminous.	Bituminous.
Weight on front truck, in working order	35,112 lbs.	38,528 lbs.	33,908 lbs.	32,704 lbs.	21,840 lbs.	16,184 lbs.
" " back "	19,712 "	....	....	....	....	....
Total weight on driving wheels " "	66,584 "	67,424 lbs.	52,360 lbs.	53,592 lbs.	96,572 lbs.	84,028 lbs.
" " of engine " "	121,408 "	105,952 "	86,268 "	86,296 "	118,412 "	100,212 "
" " " " and tender " "	No tender.	190,848 "	160,868 "	160,896 "	199,388 "	180,412 "
From center of front truck to center of main driving wheels	10 ft. 8 in.	12 ft. 2 in.	12 ft. 2 in.	10 ft. 8 in.	15 ft. 2 in.	14 ft. 8¾ in.
" " " cylinders	10 " 8 "	12 " 2 "	12 " 2 "	10 " 8 "	11 " 7 "	11 " 4¾ "
" " to center of front truck wheels	6 " 6 "	6 " 6 "	6 " 6 "	6 " 6 "	....	....
" " of front truck to center of front driving wheels	....	....	....	....	8 ft.	7 ft. 6¼ in.
" " " driving wheels " " " main	....	....	....	....	7 ft. 2 in.	7 " 2 "
" " " main " " " " back	8 ft.	8 ft. 6 in.	8 ft. 6 in.	8 ft.	8 " 6 "	8 " 6 "
" " " back " " " " " truck	7 " 4 in.	....	....	....	....	....
Rigid wheel base	8 "	8 ft. 6 in.	8 ft. 6 in.	8 ft.	15 ft. 8 in.	15 ft. 8 in.
Total wheel base of engine	29 " 3 "	23 " 11 "	23 " 11 "	21 ft. 11 in.	23 " 8 "	23 " 2¼ "
" " " " " and tender	No tender.	47 " ⅛ "	46 " 11 "	45 " 2⅜ "	46 " 7¼ "	46 " ⅛ "
" length of engine and tender over all	30 ft. 7¾ in. en. only	57 " 11⅛ "	57 " 11⅝ "	56 " 2⅛ "	56 " 7¼ "	56 " ⅛ "
Length of main connecting rod, center to center	6 ft. 10 in.	8 "	7 " 10 "	6 " 10 "	7 " 3 "	7 " 3 "
CYLINDERS, VALVES, ETC.						
Transverse distance from center to center of cylinders	6 ft. 4 in.	6 ft. 4 in.	6 ft. 3½ in.	6 ft. 4 in.	6 ft. 9 in.	6 ft. 9 in.
Diameter of high pressure cylinder	17 in.	18 in.	18 in.	17 in.	19 in.	18 in.
" " low " "	....	....	....	....	29 "	....
Stroke of piston	22 in.	24 in.	26 in.	22 in.	26 "	26 in.
Kind " "	"C. I." box.	"C. I." box.	"C. I." box.	"C. I." box.	"C. I." box.	"C. I." box.
Horizontal thickness of H. P. piston head in the center	4¾ in.	4¾ in.	4¾ in.	4¾ in.	4¾ in.	4¾ in.
" " " L. P. " " " "	....	....	....	....	5¾ "	....
Kind of piston packing	"C. I." rings sprung in.	"C. I." rings sprung in.	"C. I." rings sprung in.	"C. I." rings sprung in.	"C. I." rings sprung in.	"C. I." rings sprung in.
Diameter of H. P. piston rod	2⅞ in.	3⅛ in.	3⅛ in.	2⅞ in.	3⅜ in.	3⅛ in.
" " L. P. " "	....	....	....	....	3⅜ "	....
Size of H. P. steam ports	16 in. × 1¼ in.	18 in. × 1¼ in.	16 in. × 1¼ in.	16 in. × 1¼ in.	18 in. × 1⅛ in.	16 in. × 1¼ in.
" " L. P. "	....	....	....	....	22½ " × 1⅛ "	....
" " H. P. exhaust "	16 in. × 3 in.	18 in. × 3¼ in.	16 in. × 3 in.	16 in. × 3 in.	18 " × 3 "	16 in. × 3¼ in.
" " L. P. "	....	....	....	....	22½ " × 3 "	....
Greatest travel of slide valves	5 7/16 in.	5⅝ in.	5⅝ in.	5 7/16 in.	6¼ in.	5¼ in.
Throw of eccentrics	5½ "	5½ "	5½ "	5½ "	5 "	5 "
Inside lap of H. P. slide valve (or inside clearance)	1/32 "	Line and line.	Line and line.	1/32 "	Inside clear., ⅜ in.	Line and line.
" " " L. P. " " " "	....	....	....	....	" " ¼ "	....
Outside " " H. P. " "	13/16 in.	⅞ in.	⅞ in.	13/16 in.	1 in.	⅞ in.
" " " L. P. " "	....	....	....	....	⅞ "	....
Lead of H. P. slide valve in full gear	3/16 in.	⅛ in.	⅛ in.	3/16 in.	3/32 "	⅛ in.
" " L. P. " " " " "	....	....	....	....	3/32 "	....
Throw of upper end of reverse lever from full gear forward to full gear backward, measured on the chord of the arc of its throw	4 ft. 1⅞ in.	4 ft. 1¾ in.	4 ft. ⅛ in.	4 ft. 3⅞ in.	3 ft. 11¼ in.	3 ft. 11¼ in.
Sectional area of opening of H. P. steam pipe	15.9 sq. in.	17.72 sq. in.	16.80 sq. in.	15.9 sq. in.	23.76 sq. in.	17.72 sq. in.
" " " dry pipe	28.29 " "	28.29 " "	28.29 " "	28.29 " "	28.29 " "	28.29 " "
Cubic capacity of receiver	....	....	....	....	4.25 " ft.	....
WHEELS AND AXLES.						
Diameter of driving wheels, outside of tire	5 ft. 2 in.	6 ft. 1⅝ in.	6 ft. 6 in.	5 ft. 2 in.	5 ft. 2 in.	5 ft. 2 in.
Material of centers and style of tire fastenings	"C. I. Mansell" clip.	"C. I. Mansell" clip.	"W. I." forged spoke, Beattie clip and tire bolts.	"C. I." tire bolts.	"C. I. Mansell" clip.	"C. I. Mansell" clip.
Diameter of front truck wheels, outside of tire	33 in.	37 in.	37 in.	33 in.	37 in.	37 in.
Material of centers and style of tire fastenings	"C. I. Mansell" clip.	"C. I. Mansell" clip.	W. I." forged spoke, Beattie clip and tire bolts.	"C. I. Mansell" clip.	"C. I. Mansell" clip.	"C. I. Mansell" clip.
Diameter of back truck wheels, outside of tire	33 in.	....	....	....	....	....
Material of centers and style of tire fastenings	"C. I. Mansell" clip.	....	....	....	....	....
Size of front driving axle journals, diameter × length	....	....	....	....	7 in. × 8 in.	7 in. × 8 in.
" " main " " " "	7 in. × 8 in.	8 in × 9 in.	8 in. × 9 in.	7 in. × 8 in.	7 " × 8 "	7 " × 8 "
" " back " " " "	7 " × 8 "	8 " × 9 "	8 " × 9 "	7 " × 8 "	7 " × 8 "	7 " × 8 "
" " front truck " " "	4½ " × 7½ "	5½ " × 10 "	5 " × 7¾ "	4½ " × 7½ "	5½ " × 10 "	5 " × 7¾ "
" " back " " " "	5½ " × 10 "	....	....	....	....	....
" " main crank pin "	4 " × 5 "	5¼ in. × 5¼ in.	4½ in. × 5 in.	4 in. × 5 in.	4½ in. × 5 in.	4½ in. × 5 in.
" " wrist pin "	3¼ " × 3¾ "	3¾ " × 3¾ "	3½ " × 3 "	3¼ " × 3¾ "	3¾ " × 3 "	3¾ " × 3 "
" " front coupling rod "	....	....	....	....	5 " × 3¼ "	5 " × 3¼ "
" " Main " " "	3¼ in. × 4 in.	3¾ in. × 3¾ in.	3¾ in. × 3¾ in.	3¼ in. × 4 in.	5½ " × 4½ "	5½ " × 4½ "
" " back " " "	3¼ " × 4 "	3¾ " × 3¾ "	3¾ " × 3¾ "	3¼ " × 4 "	5 " × 3½ "	5 " × 3½ "
Length of front truck springs, center to center of hangers	2 ft. 11⅛ in.	2 " × 11⅛ "	2 " × 11⅛ "	2 ft. 11⅛ in.	2 ft. 6 in.	2 ft. 6 in.
Number of plates	10.	13.	13.	11.	8.	7.
Section of steel	3½ in. × ½ in.	3½ in. × ½ in.	3½ in. × ½ in.	3½ in. × ½ in.	3½ in. × ½ in.	3½ in. × ½ in.
Length of driving springs, center to center of hangers	3 ft. 3½ in.	3 ft. 3½ in.	3 ft. × 3½ "	3 ft. 3½ in.	2 ft. 10 in.	2 ft. 10 in.
Number of plates	12.	12.	12.	10.	10.	9.
Section of steel	4 in. × ½ in.	3½ in. × ½ in.	3½ in. × ½ in.	4 in. × ½ in.	3½ in. × ½ in.	3½ in. × ½ in.
Length of back truck springs, center to center of hangers	2 ft. 6 in.	....	....	....	....	....
Number of plates	8.	....	....	....	....	....
Section of steel	3½ in. × ½ in.	....	....	....	....	....
BOILER.						
Description of boiler	Straight back.	Straight back.	Straight back.	Straight back.	Straight back.	Straight back.
Inside diameter of smallest ring of boiler	4 ft. 0¾ in.	4 ft. 2¾ in.	4 ft. 2¾ in.	4 ft. 0⅝ in.	4 ft. 2¾ in.	4 ft. 2¾ in.
Material of barrel of boiler	Steel.	Steel.	"Bowling" iron.	"Bowling" iron.	Steel.	Steel.
Length of barrel from back of front tube plate to front of throat	10 ft. 4 in.	11 ft. 10¾ in.	11 ft. 10¾ in.	10 ft. 4 in.	11 ft. 2¼ in.	11 ft. 2¼ in.
Thickness of plates in barrel of boiler	⅜ in.	½ in.	½ in.	7/16 in.	½ in.	½ in.
Kind of horizontal seams	Butt, inside and outside welts, double riveted.	Butt, inside and outside welts, double riveted.	Butt, inside and outside welts, double riveted.	Lap, double riveted.	Butt, inside and outside welts, double riveted.	Butt, inside and outside welts, double riveted.
" " circumferential seams	Lap, double Riveted.	Lap, double riveted.	Butt, with welt outside and single riveted.	Lap, double riveted.	Lap, double riveted.	Lap, double riveted.
Material of tubes	Charcoal iron.	Charcoal iron.	Charcoal iron.	Charcoal iron.	Charcoal iron.	Charcoal iron.
Number " "	173.	190.	212.	196.	190.	190.
Diameter " " outside	1¾ in.	1¾ in.	1¾ in.	1¾ in.	1¾ in.	1¾ in.
Distance between centers of tubes	2 7/16 "	2 7/16 "	2⅜ "	2⅜ "	2 7/16 "	2 7/16 "
Length of tubes over tube plates	10 ft. 8 5/16 in.	12 ft. 5 1/16 in.	12 ft. 3 1/16 in.	10 ft. 8 5/16 in.	11 ft. 9 1/16 in.	11 ft. 9 1/16 in
" " firebox outside	6 " 2 "	6 " 9 "	6 " 9 "	6 " 2 "	6 " 9 "	6 " 9 "
Width " " "	Mean, 3 ft. 10¼ in.	3 " 6⅝ "	3 " 6⅛ "	Mean, 3 ft. 10¼ in.	3 " 6⅝ "	3 " 6⅝ "
Length " " inside at foundation ring	5 ft. 6 5/16 in.	6 " 2 1/16 "	6 " 1 1/16 "	5 ft. 6 5/16 in.	6 " 2 1/16 "	6 " 2 1/16 "
Width " " " " "	Mean, 3 ft. 2⅞ in.	2 " 11⅞ "	2 " 11 "	Mean, 3 ft. 2⅞ in.	2 " 11⅞ "	2 " 11⅞ "
Depth " " " from bottom of foundation ring	" 5 " 0⅝ "	5 " 9¼ "	6 " 2⅛ "	5 ft. 4¼ in.	5 " 9¼ "	5 " 9⅝ "
Water space, sides of firebox at foundation ring	3 in.	2½ in.	3 in.	3 in.	2½ in.	2½ in.
" " back " " " " "	3 "	2½ "	3 "	3 "	2½ "	2½ "
" " front " " " " "	3 "	2½ "	3 "	3 "	2½ "	2½ "
Material of outside shell of firebox	Steel.	Steel.	"Bowling" iron.	"Bowling" iron.	Steel.	Steel.
Thickness of plates of outside shell of firebox—throat, face, sides, saddle	7/16 in., ⅜ in., ⅜ in., ½ in.	9/16 in., ½ in. 7/16 in., 9/16 in.	9/16 in., ½ in., 7/16 in., 7/16 in.	7/16 in., ⅜ in., ⅜ in., ½ in.	9/16 in., ½ in., 7/16 in., 9/16 in.	9/16 in., ½ in., 7/16 in., 9/16 in.
Material of inside of firebox	Steel.	Steel.	Steel.	Steel.	Steel.	Steel.
Thickness of side sheets of firebox	5/16 in.	5/16 in.	5/16 in.	5/16 in.	5/16 in.	5/16 in.
" " back sheet " "	⅜ "	⅜ "	⅜ "	⅜ "	⅜ "	⅜ "
" " " tube sheet	½ "	½ "	½ "	½ "	½ "	½ "
" " crown sheet	⅜ "	⅜ "	⅜ "	⅜ "	⅜ "	⅜ "
Material of front tube sheet	Steel.	Steel.	"Bowling" iron.	"Bowling" iron.	Steel.	Steel.
Thickness " " " "	⅝ in.	¾ in.	¾ in.	⅝ in.	¾ in.	¾ in.
How crown sheet is stayed	Radial, 1⅛ in. diameter.	Radial, 1⅛ in. diameter, two front rows fitted for expansion.	Radial, 1⅛ in. diameter, two front rows fitted for expansion.	Radial, 1⅛ in. diameter.	Radial, 1⅛ in. diameter, two front rows fitted for expansion.	Radial, 1⅛ in. diameter, two front rows fitted for expansion.
Diameter of dome inside	2 ft. 1 in.	2 ft. 5½ in.	2 ft. 1 in.	2 ft. 1 in.	2 ft. 5½ in.	2 ft. 5½ in.
Height " " to joint face	2 " 9 "	2 " 11⅝ "	2 " 9 "	2 " 9 "	2 " 11⅝ "	2 " 11⅝ "
Extension smokebox, outside diameter by length from joint face of front to face of tube sheet	4 ft. 5½ in. × 5 ft. 3⅜ in.	5 ft. 0 in. × 5 ft. 8¼ in.	5 ft. 0 in. × 5 ft. 7¾ in.	4 ft. 5½ in. × 5 ft. 3⅜ in.	5 ft. 0 in. × 4 ft. 5½ in.	5 ft. 0 in. × 5 ft. 8¼ in.
Maximum working pressure per square inch	140.	180.	160.	140.	180.	160.
Kind of grate	"C. I." rocking.	"C. I." rocking.	"C. I." rocking.	"C. I." rocking.	"C. I." rocking.	"C. I." rocking.
Width of grate bars	½ in. at points and ⅞ in. at root.	½ in. at points and ⅞ in. at root.	½ in. at points and ⅞ in. at root.	½ in. at points and ⅞ in. at root.	½ in. at points and ⅞ in. at root.	½ in. at points and ⅞ in. at root.
" " air space between grate bars	⅝ in. 1/32.	⅝ in.	⅝ in.	⅝ in. 1/32.	⅝ in.	⅝ in.
Grate area	17.85 sq. ft.	18.25 sq. ft.	17.75 sq. ft.	17.85 sq. ft.	18.25 sq. ft.	18.25 sq. ft.
Heating surface, firebox	96.50 "	106.50 "	119.50 "	102.20 "	106.50 "	106.50 "
" " outside of tubes	848.00 "	1,077.35 "	1,184.07 "	950.00 "	1,015.61 "	1,015.61 "
Total heating surface	944.50 "	1,183.85 "	1,303.57 "	1,052.20 "	1,122.11 "	1,122.11 "
Effective cross sectional area through tubes	2.21 "	2.44 "	2.71 "	2.50 "	2.44 "	2.44 "
Kind of blast nozzle	Single.	Single.	Single.	Single.	Single.	Single.
Diameter of blast nozzle	4 in.	4¼ in.	4¼ in.	4 in.	4 7/16 in.	4¼ in.
Smallest inside diameter of stack	1 ft. 3⅝ in.	1 ft. 5⅝ in.	1 ft. 5⅝ in.	1 ft. 4⅝ in.	1 ft. 1 in.	1 ft. 5⅝ in.
Height from top of rail to top of stack	13 " 0 "	14 " 5 "	14 " 9 "	14 " 1 "	14 " 1⅞ "	14 " 1⅝ "
" " " " " " center of boiler	6 " 3⅛ "	6 " 10⅝ "	7 " 0 "	6 " 3⅛ "	7 " 0 "	6 " 7⅝ "
Style of frames	Bar in front and slab at back.	Bar throughout.	Bar throughout.	Bar in front and slab at back	Bar throughout.	Bar throughout.
" " driver brakes	American equalized on drivers and trailers.	American equalized clasp on drivers and trailers.	None.	None.	None.	None.
System of sanding	"Gresham's" patent steam sanding for D. & T.	"Gresham's" patent steam sanding.	"Gresham's" patent.	Ordinary, by hand.	Ordinary, by hand.	Ordinary, by hand.
Style and size of injectors	G. T. R. Nos. 7 and 8.	Holden & Brook's Combination, 1892. Nos. 8 and 9.	G. T. R. Nos. 8 and 9.	G. T. R. Nos. 7 and 8.	Holden & Brook's Combination, 1892. Nos. 8 and 9.	G. T. R. Nos. 8 and 9.
Engines are fitted with baffle plates, firebrick arches and water tubes for carrying same.						
Service for which engine is intended	Suburban.	Express.	Express.	Light passenger.	Freight.	Freight.
Water capacity of side and back tanks in gallons of 231 cubic inches	1,500 gals.	....	....	....	....	....
Capacity of coal space, cubic feet	93 cu. ft.	....	....	....	....	....

(*d*) Five conical stacks with an inclination of $\frac{1}{6}$ and the same minimum diameter, as shown in Fig. 17:

(*e*) Three funnel-shaped stacks (without a waist), of which one had an inclination of $\frac{1}{6}$ and a minimum diameter of 13.78 inches, and two having inclinations of $\frac{1}{12}$ and minimum diameters of 13.78 inches and 15.75 inches, as shown in Fig. 18.

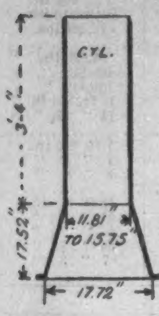


Fig. 15.

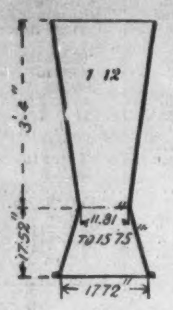


Fig. 16.

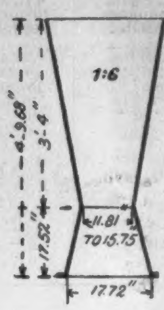


Fig. 17.

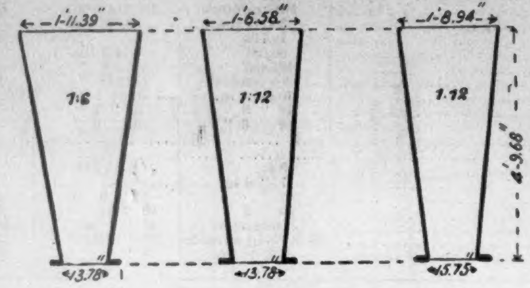


Fig. 18.

In the steam pipe leading from the boiler to the apparatus, which had a diameter of 2.76 inches, a cut-off valve, a throttle valve and a metallic manometer were placed. The throttle valve was fastened in a convenient

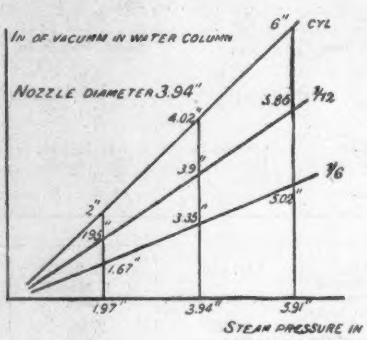


Fig. 19.

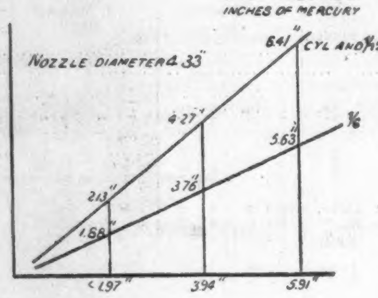


Fig. 20.

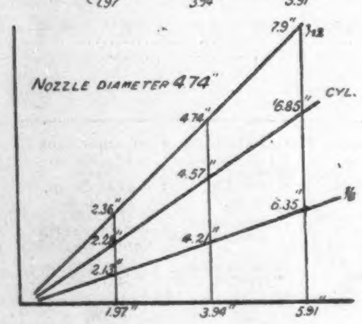


Fig. 21.

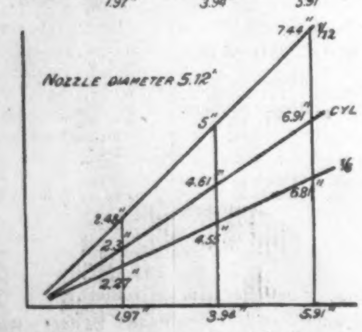


Fig. 22

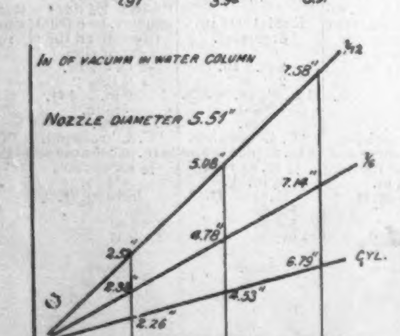
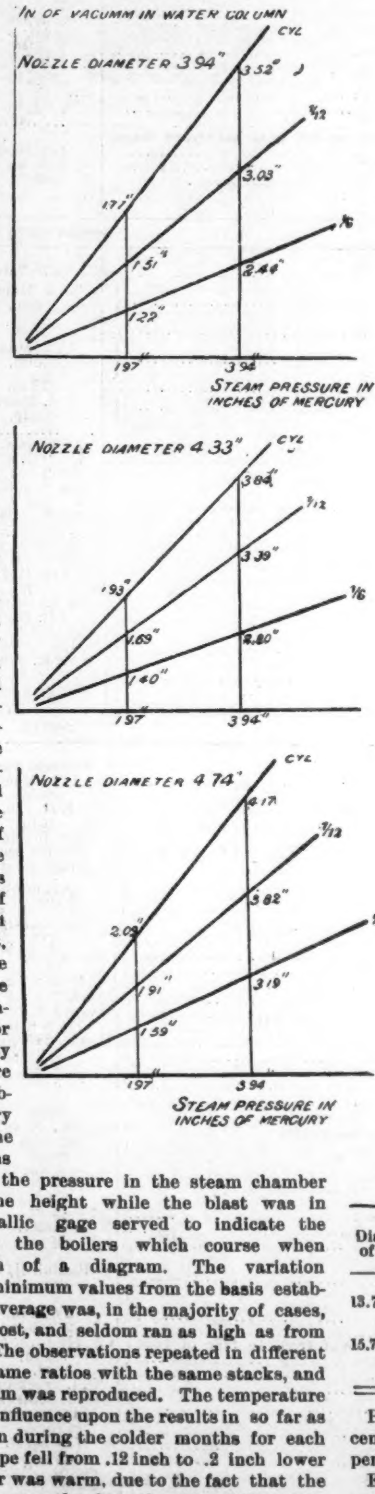


Fig. 23.

position near to the apparatus where a wooden booth was set up, in which the measuring instruments were placed and from which the apparatus itself could be readily watched through a window. A reading o the instruments in the open, while the apparatus was in blast, would not have been possible, since the outrushing steam made an ear-bursting racket, and the stack emitted the hot condensation of the steam, while showers of water prevailed all about.

Before an experiment began the apparatus, whose steam chamber was well protected by a thick layer of felt against cooling, was thoroughly warmed. The water of condensation of this chamber was carried off by a pipe that was left was held within the limits of from 67 pounds to 75 pounds per square inch. In order that this great outpouring of steam might be maintained it was found necessary to force all three boilers of a neighboring battery up to their full power, though ordinarily they served to supply steam to a small steam engine and several steam hammers. With only two boilers in service, though the fires might be burning briskly, the steam pressure would gradually drop as much as four inches in the mercury column, which rendered accuracy in the results impossible; though this same variation was not observable in the metallic gage. This is offered in explanation of the contradictory results obtained by the Prüssmann experiments. While with him the pressure of the very small amount of steam emitted was measured by a sensitive instrument, the small variations of boiler pressure were allowed to pass unheeded, though they had the greatest influence upon the amount of steam emitted; in tne Hanover experiments the great outflow of steam was controlled by a delicate instrument. In consequence of the latter condition and the making of a great number of observations, for in all more than thirty thousand readings were taken, the values obtained showed a very uniform open during the experiment. By means of the throttle valve the pressure in the steam chamber was kept at the same height while the blast was in operation. The metallic gage served to indicate the pressure existing in the boilers which course when plotted in the form of a diagram. The variation of the maximum and minimum values from the basis established by the general average was, in the majority of cases, about .04 inch at the most, and seldom ran as high as from .08 inch to .12 inch. The observations repeated in different months gave the the same ratios with the same stacks, and always the same vacuum was reproduced. The temperature of the air only had an influence upon the results in so far as that the readings taken during the colder months for each position of the blast pipe fell from .12 inch to .2 inch lower than when the weather was warm, due to the fact that the current of steam clung more closely to the sides of the stack. This affects, then, only the boundary limits of the dropping ends of the curves, and consequently the position of the nozzle, which is not changed in practice, and is, therefore, of no importance in connection with the respective stacks.

Figs. 24 to 26.



We next took up the task of establishing the relationship existing between the pressure in the blast-pipe and the vacuum. Already in his experiments with a locomotive under steam but stationary, Clark had obtained results sufficient to prove the proposition that the vacuum stands in a direct ratio to the blast-pipe pressure. This was investigated with the apparatus with stacks having the greatest variations of diameter and length and with all five of the blast nozzles, and was found to be in exact correspondence in every instance.

If we take the blast-pipe pressure as abscissas and the corresponding vacuums as ordinates, the end points of the latter will form straight lines. In Figs. 19 to 23 these diagrams are given for the operation of a stack having a diameter of 13.78 inches. The blast-pipe position for all 15 of the readings was the same, or 1 foot 10 inches. Equal abscissas correspond to equal steam pressures. If the latter were twice, four times, or five times as great, the vacuum would increase twofold, fourfold, or fivefold, as the case might be.

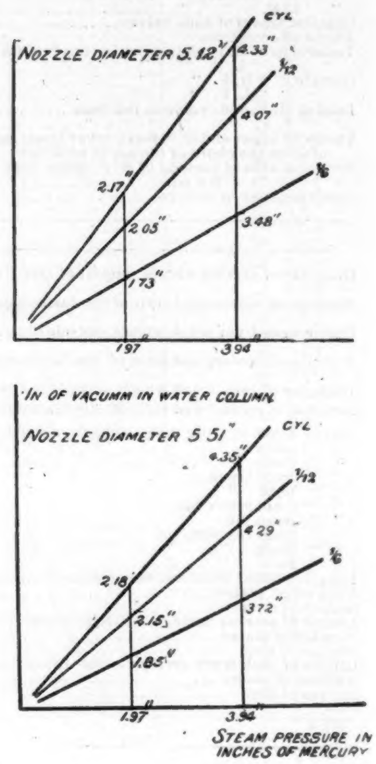
The amount of steam issuing forth increases as the diameter of the nozzle is made larger, about in the ratio of the square of the diameter of the nozzle. If we consider that the amount of steam issuing from a nozzle 4 inches in diameter to be equal to 1, it follows that, with the same steam pressure and a

Nozzle diameter	= 4 inches,	the steam delivered	= 1.00
" "	= 4.4 "	" " "	= 1.21
" "	= 4.8 "	" " "	= 1.44
" "	= 5 2 "	" " "	= 1.69
" "	= 5.6 "	" " "	= 1.96

Notwithstanding the fact that with a nozzle diameter of 5.6 inches, nearly twice as much steam is delivered as would be through one only 4 inches in diameter, a casual comparison of these five diagrams shows that the vacuum rises in a far smaller ratio.

To make this still clearer, the following figures are brought together.

Figs. 27 and 28.



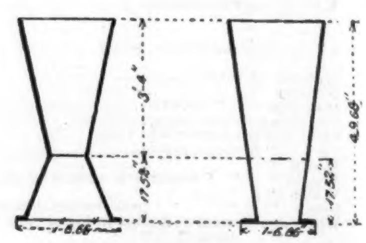


Fig. 29.

TABLE I.

Diameter of stack.	Shape of stack.	Increase in the vacuum with the nozzle lacated at 22 in., if the nozzle diameter is opened from 4 in. to 5.6 in.
13.78 in....	Cylindrical..	From 4.08 to 4.6 in. = .52 in. = 12.7 per ct.
	Conical $\frac{1}{12}$...	" 3.96 " 5.14 " = 1.18 " = 30.7 "
	Conical $\frac{1}{6}$....	" 3.4 " 4.84 " = 1.44 " = 42.3 "
15.75 "	Cylindrical..	" 3.58 " 4.42 " = .84 " = 23.4 "
	Conical $\frac{1}{12}$...	" 3.08 " 4.36 " = 1.28 " = 41.5 "
	Conical $\frac{1}{6}$....	" 4 88 " 3.78 " = 1.1 " = 52.4 "

Hence, if the outflow of steam increases by about 100 per cent., the vacuum (under this ratio) will increase about 52 per cent., the shape of the stack remaining the same.

From these five diagrammatic representations we can readily see, without any further demonstration, how a cylindrical stack having a diameter of 13.78 inches falls off in its action with the same amount of steam as compared with the conical stack. With a nozzle diameter of 4 inches the cylindrical form seems to be the best when taken in connection with the height of the vacuum; at a diameter of 4.4 inches it nearly coincides with the conical form having an inclination of one-twelfth; with a further opening of the blast nozzle it drops down below the last-named form, until at a diameter of 5.2 inches for the nozzle it has fallen even below the stack having an inclination of one-sixth.

In other respects the diagrams show that the action of the cylindrical stacks is very much better than that of the coni-

cal if we take stacks having a larger diameter than 13.78 inches. It so happens, then, that under the same ratios as shown in Figs. 19 to 23, that with stacks having a diameter of 14.76 inches, the cylindrical stack first coincides with the conical stack having an inclination of one-twelfth when the nozzle has a diameter of 5.06 inches. With a diameter of 15.75 inches, as well as with all five diameters of nozzle, the cylindrical form is superior to the conical (the nozzle position being 1 foot 10 inches) as is shown by Figs. 24 to 28.

We next have to show the reason why we believe, from the results obtained from the experimental apparatus, that a cylindrical stack 13.78 inches in diameter and 4 feet 9.68 inches high, is too small to be used with a nozzle 4.33 inches in diameter, just as a stack of 14.76 inches in diameter is too small for a nozzle having a diameter of 5.06 inches or more. And we are inevitably led to the further conclusion that the cylindrical stack, as being also superior at the smallest cross-section, must be preferred to the conical stack if we expect to maintain the same vacuum with the two forms under the same conditions. Likewise the conical stack should be given different inclinations, and the narrow inclination of $\frac{1}{12}$ be increased to $\frac{1}{6}$, as shown later in Section X.

Finally, we can state, as a well-defined conclusion, that the blast-pipe pressure has no influence upon the form of the stack, a conclusion that Prüssmann has already announced as the result of his experiments. Figs. 19 to 23 and 24 to 28 show this to be the case without the necessity of any further references; for the trend of the vacuum lines for the three different shapes of stacks maintains the same relationship to each other for all blast-pipe pressures, the nozzle diameters remaining the same. This position permits one to choose any steam pressure that may be desired for the experiments, even though it may not exactly correspond with the blast-pipe pressures as they exist in the locomotives. The Hanover experiments were now conducted with a steam pressure of 3.94 inches of the mercury column, a value which, as was afterward established, corresponded almost exactly with that existing on the standard passenger locomotives when running at a speed of from 34 to 37 miles per hour, a cut-off at .2 stroke, and exhausting through a nozzle of 4.74 inches in diameter. All of the experiments with the 18 stacks, of which 15 were in four different lengths, were made with this steam pressure, the openings into the air chamber remaining the same, and all other conditions being unchanged.

Each stack was tested with five different diameters of nozzle openings. In all there were 320 different combinations of stack and nozzle relations tested. In each of these relations there were at least 10 different positions of the nozzle employed and as many curve points marked with six readings each for the purpose of reaching a definite conclusion.

(*To be Continued.*)

The Holding Power of Lag Screws.

A correspondent in the *American Machinist* gives the following information concerning some experiments he made on the holding power of lag screws:

The holes were bored by a common carpenter's bit in 8-inch square logs, and the screws put in same as would be in common practice, and they were pulled out by the use of an Olsen testing machine.

Diameter of screw.	Diameter of bit.	Length of thread screwed into the wood.	Kind of wood.	The load at which screw pulled out.
7/8 inch.	5/8 inch.	3 Inches.	Spruce	5,900 lbs.
7/8 "	11/16 "	3 "	"	5,900 "
7/8 "	3/4 "	3 "	"	6,000 "
7/8 "	3/4 "	5 "	"	9,000 "
7/8 "	3/4 "	5 "	Chestnut	9,500 "
3/4 "	5/8 "	4½ "	Spruce	7,000 "
3/4 "	5/8 "	4½ "	Pitchpine.	8,300 "
5/8 "	1/2 "	4 "	Spruce	6,000 "
1/2 "	3/8 "	3½ "	"	3,500 "
3/8 "	5/16 "	2 "	"	1,900 "
1/4 "	3/16 "	1 "	"	700 "

This experiment seems to indicate that there is no advantage in using too small a bit when boring holes for lag screws. For instance, the $\frac{7}{8}$ screw required full as much force to pull out from a $\frac{3}{4}$ hole as it would take to pull out of a $\frac{5}{8}$ hole, although it is a great deal easier to put the screw in after a $\frac{3}{4}$ bit than it is after a $\frac{5}{8}$ bit, and it is certainly work spent in the wrong direction to use a bit smaller than the core of the screw.

By splitting the block and examining the wood around the screws, it will be found that when too small bits are used, the fibers in the wood around the screws are crushed and destroyed, but when the right size of bit is used the thread in the wood around the screw looks clean cut, the texture of the fibers is pressed and the fit in the wood on the screw resembles the appearance of a nut on a bolt.

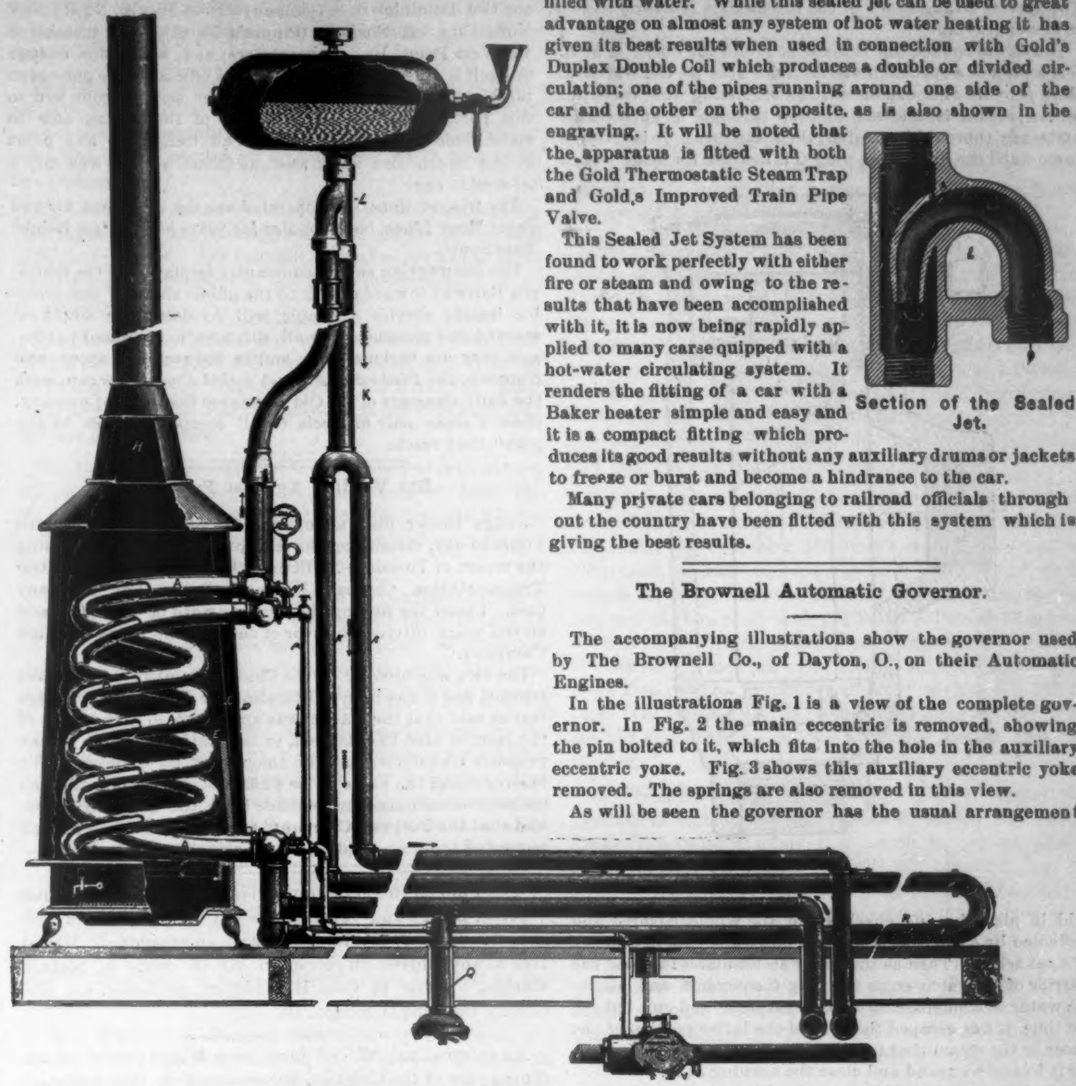
When the $\frac{7}{8}$ screw was screwed into a $\frac{3}{4}$ hole its full length of thread, or five inches, it required a force of 9,000 pounds to pull it out; therefore it is safe enough for any temporary job under a steady stress to lift one ton in a $\frac{7}{8}$ lag screw, as this gives about four as factor of safety in pulling out of the wood, and there is no danger of pulling off the screw itself, because at the place of the core where it could break it is about $\frac{11}{16}$ inch, in diameter = 0.37 square inch area.

Assuming ultimate tensile strength to be 50,000 pounds per square inch, the breaking load would be 50,000 × 0.37 = 18,500 pounds; thus there is no danger at all of the screw itself breaking for a load of a ton.

Gold's Improved Sealed Jet System of Hot Water Circulation.

A great improvement and advancement in a hot water circulating system for cars equipped with the Baker heater has been recently developed by Mr. Edward E. Gold, President of the Gold Car Heating Company.

The desirable and requisite feature of this style of equipment has been to obtain a rapid circulation of the water through the pipes of the car.



Gold's Sealed Jet System of Hot Water Circulation.

The effects of the rapid circulation being the more effusive radiation of heat from the outgoing pipes of the coil, and in consequence the more thoroughly heated return.

When steam is let into the coil equipped with the Gold sealed jet, a complete circulation of the water takes place in from eight to eleven minutes, and in a correspondingly short length of time when fire is used.

Heretofore, on some few railways, it has been the practice to jet the steam into the water for the purpose of securing a more rapid circulation, but great objection has been made to this from the fact that it has been impossible to use salt water or other non-freezing liquids in the pipes when such steam or commingler jet is used. The result is that the use of fresh water is made necessary, and immediately the steam is shut off the jet or the fire extinguished the pipes are very liable to freeze and burst, and, in some cases, where the brakemen or porters have started a fire in the stove where the pipes were frozen the result has been some very terrific explosions, often blowing the car to pieces.

The Gold Sealed Jet, which can be used with any kind of water, whether fresh or salt, or the regular Gold patented non-freezing solution, the same as now being used in the Broadway cars, is a double extra heavy fitting, having somewhat the outward appearance of a back outlet return bend, but as can be seen from its sectional view in the accompanying illustration, one port of the bend is carried into the vertical section *D*, and this port so carried into the vertical section is slightly tapered like the nozzle of a water hose. At the upper end of this nozzle there is a small hole *A*, tapped to one-eighth inch.

In this condition the jet is connected with the expansion drum making only one connection into the drum. When steam is turned on the coil and the water begins to heat and rise through the pipe *J*, it enters the jet at the opening *C*, passes around through the bend and owing to the taper of the nozzle is forced down the pipe with considerable energy. Any air which might be mingled with the water will rise to the drum as the water leaves the opening *B*.

The purpose of the ⅛ inch tapping made into the nozzle at the upper side is to omit any particles of air that might settle in the jet proper when the pipes of the car are being filled with water. While this sealed jet can be used to great advantage on almost any system of hot water heating it has given its best results when used in connection with Gold's Duplex Double Coil which produces a double or divided circulation; one of the pipes running around one side of the car and the other on the opposite, as is also shown in the engraving. It will be noted that the apparatus is fitted with both the Gold Thermostatic Steam Trap and Gold's Improved Train Pipe Valve.

Section of the Sealed Jet.

This Sealed Jet System has been found to work perfectly with either fire or steam and owing to the results that have been accomplished with it, it is now being rapidly applied to many cars equipped with a hot-water circulating system. It renders the fitting of a car with a Baker heater simple and easy and it is a compact fitting which produces its good results without any auxiliary drums or jackets to freeze or burst and become a hindrance to the car.

Many private cars belonging to railroad officials through out the country have been fitted with this system which is giving the best results.

The Brownell Automatic Governor.

The accompanying illustrations show the governor used by The Brownell Co., of Dayton, O., on their Automatic Engines.

In the illustrations Fig. 1 is a view of the complete governor. In Fig. 2 the main eccentric is removed, showing the pin bolted to it, which fits into the hole in the auxiliary eccentric yoke. Fig. 3 shows this auxiliary eccentric yoke removed. The springs are also removed in this view.

As will be seen the governor has the usual arrangement of weights and springs, and belongs to that class of governors in which the eccentric swings from a fixed point. The principal feature of the governor is the manner in which the motion of the weights is transmitted to the main eccentric. As is shown in Fig. 3, the weights are connected by links to the ears of the auxiliary eccentric which is fitted to turn upon the hub of the governor wheel, so that as the weights are moved the auxiliary eccentric is turned around the shaft. This auxiliary eccentric is fitted with a yoke, or strap, which is shown in position in Fig. 2 and removed in Fig. 3. In this yoke is a hole which receives the pin bolted to the main eccentric in Fig. 2. Thus, as the auxiliary eccentric is turned around the shaft, its yoke is thrown across, carrying with it the main eccentric, which is thus moved nearer to or farther from the center, and thereby decreasing or increasing its throw.

The advantages of this combination of eccentrics are that the governor is mechanically locked in every position it assumes, and can only be moved by pulling on the weights, the pull of the valve having no effect whatever, while at the same time the governor is free and certain to act, sensitive, strong and durable.

Fig. 1.

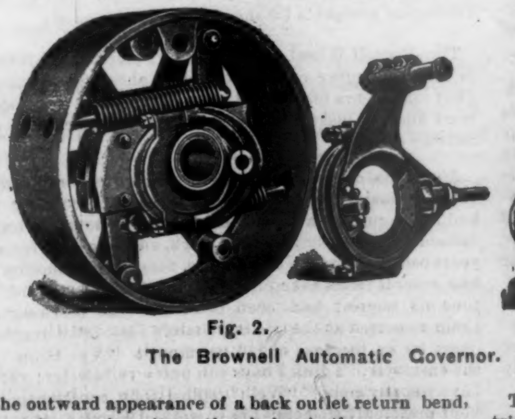


Fig. 2.

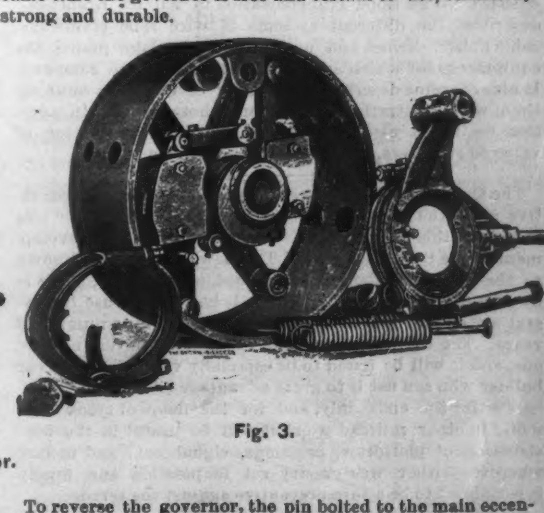


Fig. 3.

The Brownell Automatic Governor.

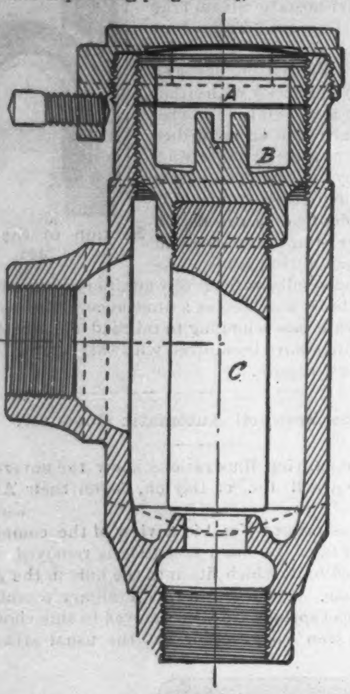
To reverse the governor, the pin bolted to the main eccentric is changed to the holes shown on the opposite side in Fig. 2, the weights and springs are changed to the holes provided for them, and the operation is complete. Engineers who have had to reverse some of the "Chinese Puzzles" on the market will appreciate the simplicity of this operation.

The governor is compact, yet all adjustable parts are very accessible. All wearing parts are circular in form, thus insuring smooth, uniform wear. The entire wear of the governor is taken up by two simple adjustments. lay, governor was designed and patented by H. C. C Supt. of The Engineering Dept. of The Brownell Co.

The Diamond Steam Trap.

The steam trap which we herewith illustrate, by means of a longtitudinal section, is one that is being made by Jenkins Bros., of 71 John street, New York. The principal upon which it acts is that a piece of metal expands as it is placed in contact with steam and closes the outlet, while as the water accumulates the metal cools, contracts and opens the outlet. The special arrangement of the mechanism is clearly shown in the engraving.

The steam connection is made at *D* and the outlet is at *E*. *C* is a plug of a special material that acts as the valve to close *D* by its own expansion. In adjusting the valve for service, steam is allowed to blow through it until all the parts are thoroughly heated, then the head *B* is screwed down until the expanding plug *C* is against its seat. It is



held in place by the cheek *A* and the whole covered and protected by a cap that is screwed down and held in position by a set screw. Then as the water accumulates in *D* and the interior of the valve cools the plug *C* contracts and allows the water of condensation to pass through and out, but by the time it has escaped the heat of the latter portion of the water or the steam that is following reheats the plug, causing it to again expand and close the opening at *D*.

Such a trap as this will take care of the water condensing in a line of 1-inch pipe 1,000 feet in length.

The wide range covered by the articles manufactured by the Trenton Iron Company is, perhaps, not generally known. One of their wide-spreading branches of specialties is the making of wire and wire ropes of all kinds, cable hoists, mine haulage and other equipments for the transportation of materials by means of wire rope. Then comes the other specialties of music wire, dress stays, corset, clock springs and umbrella wire, the quality of which is superior to that of imported brands, for quality rather than quantity is the object aimed at, and one evidence of this superior quality is to be found in the numerous awards granted them at the Columbian exposition in Chicago, where they had a large and interesting display, one feature being a coil of wire in one piece 33 miles long and weighing but 11 pounds. They have recently produced a special grade of resistance wire for electrical heaters that is meeting with great favor. Other lines are the locked wire rope, Bleicher's wire rope tramways and a bale tie known as the "Anchor" tie. To assist in the dissemination of information regarding the use of wire and wire rope they have published a little book entitled "Wire Rope Transportation in All its Branches," describing the different systems of wire rope tramways, cable hoists, surface and underground haulage plants, the equipments for which are manufactured by the company. It also contains descriptions of many of the lines built by them with illustrations taken from photographs. In addition to this it also contains considerable information of value to engineers. It is sent free on application.

The Q. & C. Co. have recently put a new wood preservative upon the market. The attention of the company was called to this in connection with its work in the development of the Servis tie plate. The new compound is known as the Q. & C. Carbolineum or wood preservative, but it is by no means an untried article, as it has been in use by several street and steam railroad companies for a number of years. The uses to which it can be applied are very numerous, and it will be found to be especially valuable to the car builder who can use it to great advantage either for car timbers or for the ends only, and for the floors of stock cars, while in other railroad work it will be useful in the construction of platforms, crossings, signal box, and in fact wherever either wet or dry rot is possible and finally it is claimed to be a sure preventive against the teredo.

CAMBRIA IRON COMPANY AND THE LATROBE STEEL COMPANY.—Mr. L. R. Pomeroy announces that he has been appointed sales agent for these two companies with an office at 33 Wall street, New York.

Messrs. Burnham Williams & Company announce tha Messrs. Samuel M. Vauclain, Alba B. Johnson and George Burnham, Jr., were admitted into partnership in their firm on Jan. 1st.

Improved Freight Service South.

In keeping with the general policy adopted by the Southern Railway since its reorganization the management has instituted an entirely new freight service, which will, no doubt, be welcomed with delight by all Southern merchants and shippers. Taking effect on December 31, 1895, this road will operate both South and North bound in connection with the Old Dominion S. S. Company, from Pier 26, N. R., New York City via Norfolk (Pinner's Point), Va., instead of via West Point, Va., as heretofore; and, while this change in itself is a manifest advantage, the officials have gone even further by introducing a daily steamer service from and to this port, which will be the means of their being able to make from 12 to 24 hours less on all freights to any point in the South and Southwest, as former service was only a tri-weekly one.

The freight lines thus operated are the Piedmont Air and Paint Rock Lines, both popular for years past as fast freight lines South.

The unswerving energy constantly displayed by the Southern Railway toward giving to the public the very best possible freight service available, will, no doubt, be amply rewarded and recognized by all shippers, in increased patronage over its various lines, and in the race for speed and dispatch, the *Piedmont Air* and *Paint Rock Lines* can, with the daily steamers of the Old Dominion Steamship Company, show a clean pair of heels to all competing lines to any points they reach.

Big Verdict Against Pullman.

Judge Butler filed an opinion in United States Circuit Court to-day, dismissing the exceptions to and confirming the report of Theodore M. Etting, the Master in the Central Transportation Company-Pullman Palace Car Company case. Under the finding there is an award of $2,522,000 and eleven years' interest in favor of the Central Transportation Company.

The suit was brought by the Central Company to recover rentals, and it has been in litigation for a long while. Judge Butler said that the Master was appointed in pursuance of the opinion filed Dec. 18, 1894, to ascertain the value of the property transferred and the amount of its earnings. The Master found the value to be $2,522,000, and reports that no estimate of earnings can be made from the data furnished, and that the Pullman Company failed to produce—though requested to do so—evidence in its possession.

The *Pilgrim* (holiday number) is full of bright sketches —prose, poetry and illustrations—by bright writers and artists. Entirely original, new and entertaining. Mailed free to any address on receipt of six (6) cents in postage stamps. Write to Geo. H. Heafford, publisher, 415 Old Colony Building, Chicago, Ill.

An enigmatical bill of fare, for a dinner served on the dining cars of the Chicago, Milwaukee & St. Paul Railway, will be sent to any address on receipt of a two-cent postage stamp. Apply to Geo. H. Heafford, General Passenger Agent, Old Colony Building, Chicago, Ill.

The passenger department of the New York Central & Hudson River Railroad has issued a pamphlet advertising New York as a winter resort. It contains 64 pages of information about hotels, theaters, shops, restaurants, notable buildings, localities, etc., and directions for getting about. There is an original map of New York, made expressly for the book, and is printed in colors. A copy will be sent free, post paid, to any address in the world on receipt of two 2-cent stamps, by George H. Daniels, General Passenger Agent, Grand Central Station, New York.

The Standard Boiler Company, of Chicago, report a good business during the past year. They have moved into their new offices, 1120 and 21 Marquette Building. These boilers are built by the well-known firm, Link-Belt Machine Company, of Chicago, who have put in new and improved machinery for their manufacture, reducing the prime cost as well as making the various parts interchangeable. During the past year a number of fine plants have been installed, among others being 4,000 horse power, for the North Chicago Street Railroad Company at their new power station at Hawthorn avenue. 500 horse power, for the Cincinnati Edison Company, at Cincinnati, O.; 600 horse power for the Western Electric Company, at their factory in Chicago, and various others. The report prospects for the coming year is good.

The Russell Wheel and Foundry Company are very busy in making logging cars; have orders ahead for two months. They make cars for special purposes, such as for soda ash work and for blast furnace works; also flat cars for street railway service.

A good-natured German, who was the prosperous proprietor of a considerable clothing business in a country town had in his employ a clerk named John, whom he had advanced from cash boy to head clerk, and who had for many years been an attache of the store. Since his promotion John had several times asked for a raise in his salary, and each time his request had been granted. One morning John again appeared at the old merchant's desk with another request for an increase of $10 per month. "Vy, Sohn," said the employer, "I dink I bays you putty vell aIretty; vat for I bays you any more?" "Well," replied John, confidently "I am your principal help here; I have worked you up a large trade; I know every detail of the business, and indeed I think you could not get along without me." "Is that so?" exclaimed the German, "Mein Gott! Shon, vot vood I do suppose you vas to die?" "Well," hesitated John, "I suppose you would have to get along without me then." The "old man" took several whiffs from his big pipe and said nothing. At last he gravely remarked: "Vell, Shon, I guess you petter gonsider yourself dead."

Our Directory

OF OFFICIAL CHANGES IN JANUARY.

We note the following changes of officers since our last issue. Information relative to such changes is solicited.

Atlanta & West Point.—Mr. Robert T. Pace has been appointed Purchasing Agent for this road and the Western Railway of Alabama.

Atlantic & Pacific.—Mr. Charles W. Smith has been appointed Receiver to succeed Messrs. Aldace F. Walker and John J. McCook, who resigned a few weeks ago.

Augusta Southern.—James N. Jackson is President and General Manager; P. H. Langdon, Vice-President, and W. F. Scofield, Superintendent, Secretary and Treasurer.

Boston & Maine.—General Manager T. A. Mackinnon has been appointed First Vice-President with authority over the operative and constructive departments. Division Superintendent Geo. F. Evans has been appointed Assistant General Manager, with headquarters at Boston, and Assistant Division Superintendent William G. Bean has been appointed Superintendent of the Southern Division with headquarters at Boston.

Baltimore & Lehigh.—Mr. G. W. Seidel has been appointed Master Mechanic, with headquarters at Baltimore, Md.

Chateaugay.—W. W. Conaughty has been appointed Superintendent.

Chicago & Great Western.—Purchasing Agent James Warwick has resigned.

Chicago, Rock Island & Pacific.—Foreman of Car Department George Heanan has been appointed General Car Inspector, with headquarters at Grand Junction, Colo.

Chicago & Eastern Illinois.—Mr. Thomas A. Lawes has been appointed Superintendent of Motive Power to succeed Mr. Allen Cooke, resigned.

Cleveland, Cincinnati, Chicago & St. Louis.—George Tozzer has been appointed Purchasing Agent.

East Broad Top.—Acting Superintendent A. W. Greenwood has been appointed Superintendent.

Erie.—General Foreman Willard Kells, of the Meadville, Pa., shops, has been appointed Master Mechanic of the Cleveland shops.

Master Mechanic George Donahue has been transferred from the Cleveland shops to Meadville, Pa.

Erie Lines West.—Col. A. M. Tucker will hereafter have the title of General Agent with headquarters at Cleveland.

Forest City & Sioux City.—John F. Way has been appointed Receiver.

Galveston, La Porte & Houston.—Messrs. T. W. House and M. T. Jones have been appointed Receivers.

Great Northern of England.—Mr. H. A. Ivatt has been appointed Locomotive Superintendent to succeed Mr. Patrick Sterling, deceased.

Hoosac Tunnel & Western.—Mr. W. D. McNeill has been appointed Master Mechanic, with headquarters at Readsboro, Vt.

Hutchinson & Southern.—Mr. L. E. Walker has been appointed Receiver.

Illinois Central.—Assistant Superintendent of Motive Power J. J. Casey has resigned.

Indiana, Decatur & Western.—The following appointments are announced: President, —— Woodford; Treasurer, F. H. Short; Auditor, G. W. Lishawa; Secretary and Purchasing Agent, George R. Balch.

Kansas City, Fort Scott & Memphis.—Freight Traffic Manager E. S. Washburn has been made Vice-President, his former office having been abolished.

Kansas City, Pittsburg & Gulf.—Mr. Ira C. Hubbell has been appointed Purchasing Agent. His duties also embrace the Texarkana & Fort Smith, and Kansas City & Independent Air Line.

Keokuk & Western.—Trainmaster J. P. Boyle has been appointed Superintendent, with headquarters at Keokuk, Iowa.

Lima Northern.—Mr. C. W. Risley has been appointed Superintendent, with headquarters at Lima.

Macon & Birmingham.—Mr. J. R. Lane has been appointed Superintendent of Transportation, Roadway and Machinery.

Missouri, Kansas & Texas.—Superintendent of Motive Power William O'Herin has been made Superintendent of Machinery and Equipment, and will have charge of both the locomotive and the car departments. The office of Superintendent of Car Department is abolished, and Mr. John Doyle has been appointed General Master Car Builder.

Nevada Southern.—R. S. Seibert is Receiver and General Manager, with office at Los Angeles, Cal.; L. Vanderwerker is General Agent for Receiver, with office at Manvel, Cal.

New York & Sea Beach.—Treasurer James T. Nelson has been appointed Receiver.

Florida Southern.—Mr. W. H. Young has been appointed Master Mechanic.

Pecos Valley.—General Manager J. N. Miller has resigned and will be succeeded by Mr. E. O. Faulkner, who has been elected Vice-President and General Manager.

Port Jervis, Monticello & New York.—The following appointments are announced: President, Thomas Waller; Vice-President, George N. McKibben; Secretary, Frederick C. Reed, and Treasurer, S. Harrison Wagner.

Rock Island & Peoria.—Mr. Hiram S. Cable has been chosen Vice-President.

St. Louis, Alton & Terre Haute.—Assistant General Manager C. F. Parker has been appointed General Manager.

St. Louis, Kennett & Southern.—L. B. Houck has been appointed Superintendent with office at Caruthersville, Mo.

Seaboard Air Line.—Mr. James Warwick has been appointed General Purchasing Agent.

South Haven & Eastern.—General Manager R. H. England has resigned and will be succeeded by Mr. M. V. Meredith, of Saginaw, Mich., formerly a Division Superintendent on the Flint & Pere Marquette.

Spokane Falls & Northern.—Assistant General Manager Austin Corbin 2d, has been promoted to General Manager.

Southern.—Mr. T. S. Inge has been appointed Master Mechanic at Burlington, N. C.

Terminal Railroad Association at St. Louis.—Yardmaster E. Dunlap has been appointed Acting Superintendent.

Vandalia Line.—President Wm. R. McKeen retired at the annual election. Superintendent J. J. Turner, of the Pittsburg, Cincinnati, Chicago & St. Louis, has been appointed Vice-President and General Manager.

Master Mechanic Wm. C. Arp, of the Pennsylvania Company, at Dennison, O., has been appointed Superintendent of Motive Power, with headquarters at Terre Haute, Ind.

Velasco Terminal.—Mr. L. L. Foster has been appointed Second Vice-President and General Manager.

Wheeling & Lake Erie.—Mr. F. C. Gates has been appointed Acting Purchasing Agent.

Employment.

A young man having a mechanical education is desirous of advancing by means of hard work and is open to an engagement as car or locomotive draftsman. He has a thorough knowledge of car construction, embracing all classes of cars used in passenger or freight service, including sleeping and parlor cars. He has had six years' experience in car drafting, latterly in charge of such work. He has a general and theoretical knowledge of locomotive work but no actual experience. References given. Address "DRAFTSMAN," care this paper.